Masters Program in Geospatial Technologies

RELATING THE SPATIAL COMPONENT AND USERS INTERESTS TO IMPROVE APPLICATIONS BASED ON QUESTIONS, PETITIONS AND PARTICIPATORY PROCESSES.

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ABSTRACT

Nowadays, participatory processes attending the need for real democracy and transparency in governments and collectives are more needed than ever. Immediate participation through channels like social networks enable people to give their opinion and become pro-active citizens, seeking applications to interact with each other. The application described in this dissertation is a hybrid channel of communication of questions, petitions and participatory processes based on Public Participation Geographic Information System (PPGIS), Participation Geographic Information System (PGIS) and 'soft' (subjective data) Geographic Information System (SoftGIS) methodologies. To achieve a new approach to an application, its entire design is focused on the spatial component related with user interests. The spatial component is treated as main feature of the system to develop all others depending on it, enabling new features never seen before in social actions (questions, petitions and participatory processes). Results prove that it is possible to develop a working application mainly using open source software, with the possibility of spatial and subject filtering, visualizing and free download of actions within application. The resulting application empowers society by releasing soft data and defines a new breaking approach, unseen so far.

KEYWORDS

Geographical Information System

WebGIS Application

Question based application

Support based application

Public Participation

Public Participation Geographic Information System

Participation Geographic Information System

SoftGIS

Spatial component

User interests

ACRONYMS

AJAX – Asynchronous JavaScript and XML

API – Application Programming Interface

BSD – Berkeley Software Distribution

CGI – Common Gateway Interface

CRS – Coordinate Reference System

CSS – Cascading Style Sheets

CSV – Comma-Separated Values

DOM – Document Object Model

EPSG - European Petroleum Survey Group

ETRS89 - European Terrestrial Reference System 1989

GeoJSON – Geographic JavaScript Object Notation

GIS – Geographic Information System

GML – Geography Markup Language

GPLv2 - General Public License

GUI – Graphical User Interface

HTML – HyperText Markup Language

HTTP – HyperText Transfer Protocol

ICT – Information and Communications Technology

INE – National Statistics Institute

JPA - Java Persistence API

JSON – JavaScript Object Notation

JSP – JavaServer Pages

NGO – Non-governmental Organization

OGC – Open Geospatial Consortium

OGP - Open Government Partnership

OSM - Open Street Maps

ORDBMS - Object-Relational Database Management System

PGIS – Participation Geographic Information System

PPGIS – Public Participation Geographic Information System

REST – Representational State Transfer Protocol

SQL – Spatial Query Language

TCP – Transmission Control Protocol

VGI – Volunteering Geographic Information

XHR– XMLHttpRequest

XML – Extensible Markup Language

WMS – Web Map Service

WFS – Web Feature Service

WWW – World Wide Web

W3C - World Wide Web Consortium

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1. Introduction

1.1. Overview

Most of the current information provided by governments is based on quantitative information and there are not allusions to the perception, the point of view and the inquisitiveness of the population. Data related to people's opinion and their experience is not gathered systematically in accurate way as quantitative information. It is easier collect quantitative (hard) data because it is less exposed to change than the users' opinion, but this last kind of data, called softdata[1], can be as important as the other.

Both governmental and non-governmental organizations have been stressing the importance of creating new ways of communication, where citizens can express themselves and give their support to social initiatives. New technologies and Internet provide a good platform to achieve the broadest participation possible, aside from traditional techniques. Both collectives *(from now, this dissertation understand as collective any aggrupation of inhabitants such as: government, enterprises, association, Non-governmental organization (NGO),etc.)* and inhabitants are waiting to be heard and have their opinions gathered on a consensus with as much people as possible, instead of having a few deciding everything.

Participation processes are becoming essential in collective actions. It is an interesting idea to provide citizenship an online channel to carry out social actions, such as asking for support on an initiative or just expressing their opinion. Citizenship has evolved and needs more resources in everyday life. Information and Communications Technology (ICT) offers new tools, with a great potential to generate and accelerate exchange and collaborative processes. These processes can be global, thanks to the Internet, but also can be local, revitalizing spaces and strengthening place attachment.

In recent years, some companies launched similar web and mobile applications with one described in this document to the market, with inexistent or unclear spatial component. (see Section 2.2) Relevant studies in Public Participation Geographic Information System (PPGIS), Participation Geographic Information System (PGIS), Volunteered geographic information (VGI) methodologies (see Section 2.1.3.4.1) and SoftGIS (see Section 2.1.3.4.2) methodology have been done over the last ten years. The localization of human experiences has a key role in regard to the applicability of social scientific knowledge, nevertheless, as pointed by K. Schmidt-Thome et al. [1], in location-based approaches, social sciences are

[1] http://dictionary.cambridge.org/dictionary/business-english/soft-data [accessed December 26th, 2014]

based on human figures, often forgetting about the personal environment, where the spatial component is crucial. Some possibilities of the resulting data from inhabitant's experiences are: cartographic information for the planning sector; signs for urban planners; joining soft and quantitative data to open new paths to other fields; and finally map-based data visualizations, that offer a good way to engage in participatory process and create debate.

These methodologies are well defined and several studies have been published [1], [2] showing great results on participative processes. The application described in this dissertation wants to give all actors of society the opportunity to start participatory processes, send a question or ask for supporting an initiative.

According to Greg Brown & Marketta Kyttä paper [3], this dissertation assumes that the difference between PPGIS and PGIS is related to the area of study, to the people behind the process and its aim (see Table 1). Thus, this application can cover both these methodologies and SoftGIS, since it is available for all the actors of society and either for urban and rural areas. The application described in this dissertation wants to go beyond an application restricted to a certain city council and become an agile system able to span all inhabitants and collectives in the society to provide them a channel where to engage questions, petition and participatory processes, bidirectional, based on spatial and user interests components.

This dissertation covers on one hand a problem of miscommunication in social issues (questions and petitions) in society and, on the other hand, it handle with participatory processes between citizens and collectives using aforementioned methodologies. The application is fully described in this document, but due to its large size and the limited time to prepare this dissertation, it is the core part of the application implemented.

1.2. Objectives

The research question of this dissertation is:

How can the spatial component be related to user interests in order to improve polls, petitions and participatory processes applications?

The main goal of this application, resulting from the research question, is to create a new channel of communication (questions, petitions and participatory processes), based on spatial component related to user interests, for society (inhabitants and collectives). Simultaneously, this spatial component can also improve the processing and visualization of the results, that can be downloaded.

This main goal can be divided into these sub-objectives:

1. To make a deep study of the current similar applications. The aim of this section is to know what are their bottlenecks, strengths and weakness. (see Section 2.2)

2. To study some cases in order to identify the suitability of spatial component and justify the approach of this dissertation. (see Section 2.3)
3. To define all the functionalities and actors of the application. (see Section 3.5)
4. To design an architecture for the application, considering the best way for the functionalities covered. (see Section 3.2)
5. To implement part of the application according to the architecture defined and mainly using open source software. (see Section 3.3)

1.3. Dissertation structure

The structure of this document is based on six chapters: *Introduction, Literature Review, Application Design and implementation, Discussion, Conclusion and References.* There are also an appendix: *Appendix A: Database.*

Introduction chapter describes the background in which the research takes place; it also defends the importance of the dissertation's subject and shows an overview of its content.

Literature Review describes all relevant concepts to understand the theoretical part behind the application, based on large number of references that have inspired this work. Then, chapter makes a revision of the different similar applications that users can find. Finally, this chapter shows some real examples where the spatial component is omitted.

Application design and implementation chapter introduces all the aspects related with both architecture and design of the application. It defines the web technologies needed, the architecture of the application, an scenario description, everything related with data management and it also describes system actors and functionalities, showing implemented pages of the application.

Discussion chapter describes the relation of dissertation's application with the application showed in *Similar Applications.* There are listed also all the limitation and difficulties, as well as new concepts founded.

Conclusion chapter answers the research's question and shows the relation with other chapters, by showing the achievements of the application and how it might be useful for its field. Furthermore, this chapter mentions features that have not been yet developed and that would be interesting to consider as future work.

Appendix A: Database tables.

2. Literature Review

2.1. Theoretical framework

The application's aim is to create a strong symbiosis between citizens, space and Internet in order to create relevant social data and trigger participatory processes. Presenting a broad background of each concept, in the following sections there is a brief explanation of them from a social perspective.

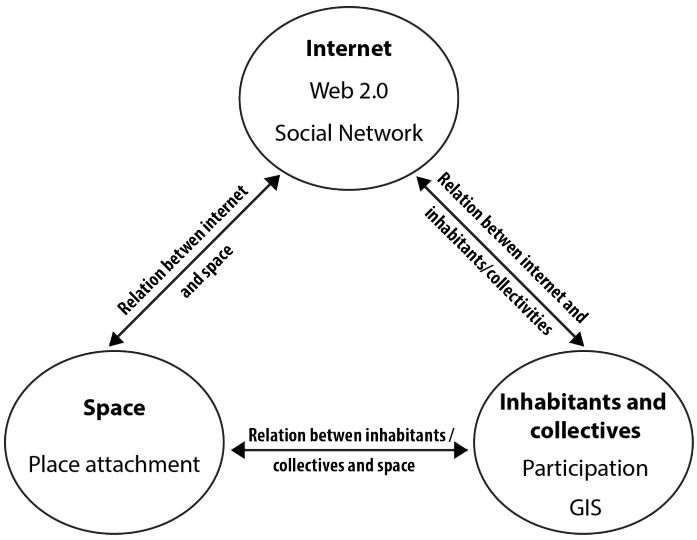

Fig 1.- Schema and relations of literature review concepts

Fig 1 shows the schema followed by this section. Following Figures (Fig 2, Fig 5, Fig 7, Fig 8, Fig 9, Fig 10) are extracted from Fig 1 to show the relation between each section with this main figure. There are three main concepts: Internet, Space and Inhabitants/Collectives. These and the relation among them conform the theoretical background behind this dissertation.

2.1.1. Internet: a social approach.

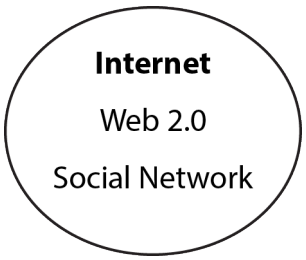

Fig 2.- Schema of Internet's section content.

Explosion of technology in our daily life has changed our habits in many fields. Information

and Communications Technology (ICT) offers us new tools with a great potential to generate and accelerate exchange and collaborative processes. New technologies are showing that alternative models are possible. Internet has allowed a level of organization and cooperation between citizens and organizations that is ahead of the modernization capacity of such organizations as city councils. Thus, the role of citizenship is becoming more complex over time; changing from "users and choosers" to "makers and shapers"[4].

Technological devices provide facilities to our daily life and work that had never been on our hands. We are redefining our social, labour and urban environment by introducing technology advances. These technologies, used by users and collectives for personal and shared empowerment are called social technologies[5]. From this perspective, the relation between user and technology result in two ways: on one hand, daily interaction creates a well-stocked two-way dialogue and on the other hand, alternatively, it is developing a citizen empowerment that leads, for instance, to autonomous collaborative projects. The dimension of social technology is as wide as unknown are its limits. For example, on an urban scope, social technology gives new ways to conceive and make cities, using a tool with a hitherto unknown power to generate exchange and collaborative processes. Internet is becoming the testing ground where culture of collaboration is being brought back. Users are creating organizations, within the network, completely disconnected from any political power, protecting their horizontal hierarchy. Nevertheless, there are huge companies that dominate a large percentage of the network, but the remaining smaller percentage can be as big as we want. Internet has become the largest information and decentralized attainable storage that has never existed [6].

2.1.1.1. Web 2.0

Based on the Web 1.0, where people unidirectionally browse the Internet making inquires, in 2005 we shifted to Web 2.0, where users are connected to others with the aim of sharing [7]. Each picture, video or text shared in Internet feeds the network. Users are nourishing the network changing the paradigm, building from bottom to up. This symbolizes a high empowerment – collective and personal – involving an enormous capacity for transformation of our social, environmental and personal reality [8].

Web 2.0 has supposed a change of mind where the verbs sharing and collaboration are the most important ones. User actions are not only concerned to consume content but to contribute and produce new content. In the web 2.0 applications users are no longer on the receiving end but rather the major contributors of the knowledge base [9], [10]. Also it is revolting ways to present, share and analyse spatial data [11].

2.1.1.2. Social network

Social networks remember our social relations. The need to communicate is an universal human condition. The aspect of organizing ourselves publicly and sharing information and knowledge goes beyond the technological development. It is a cultural and social phenomenon [12]. Social networks are enabling a new channel of communication between users and collectives seen never before. The irruption of social networks has changed our habits of communication. In contrast, by remaining permanently connected to Internet we are accepting that we are being controlled [13]. Immediate participation, through social network, enables people to give their opinion and become a pro-active citizen in contrast with vote system in Spain each four years, for instance.

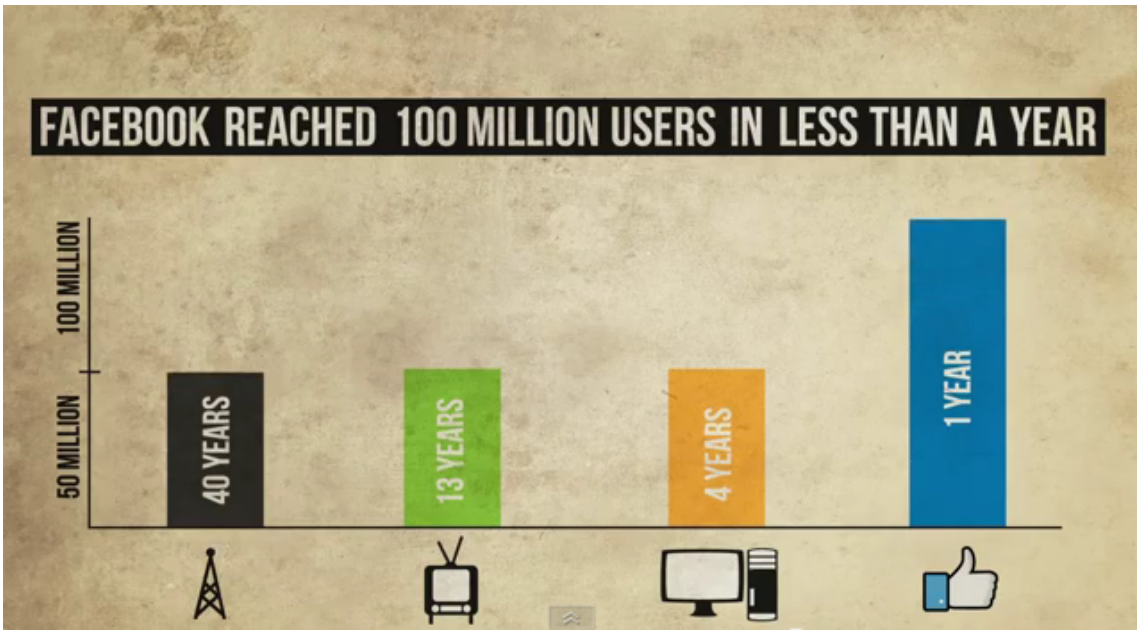

Fig 3.- Comparison between channels of information and communication.[2]

In 2014, the 42,3% of population in the world has Internet connection[3]. If we focus in this percentage, the most important applications with rapid development within the network have been social networks. If treated like only a channel of communication and information, we can compare with the rest of them. Fig 3 shows the incredible growth that this specific social network, Facebook[4], has experienced, in comparison with traditional media. While radio, television and Internet have needed between 40 and 4 years to have 50 million users, Facebook took less than a year to attract 100 million users.

[2] http://www.lovesocial.org [accessed December 26th, 2014]
[3] http://www.internetworldstats.com [accessed December 26th, 2014]
[4] https://www.facebook.com [accessed December 26th, 2014]

Humans took information from public spaces (markets, social meetings…) in XIX century. Then, as humans needed more information, technology evolved and radio (late XIX and early XX) and television (around 1927) appeared. Nowadays, Internet, blogs and social networks are complementing radio and television with an unprecedented increase of users.

Abraham Maslow [14] defined a pyramid that can explain some reasons of the increase of social networks in our society.

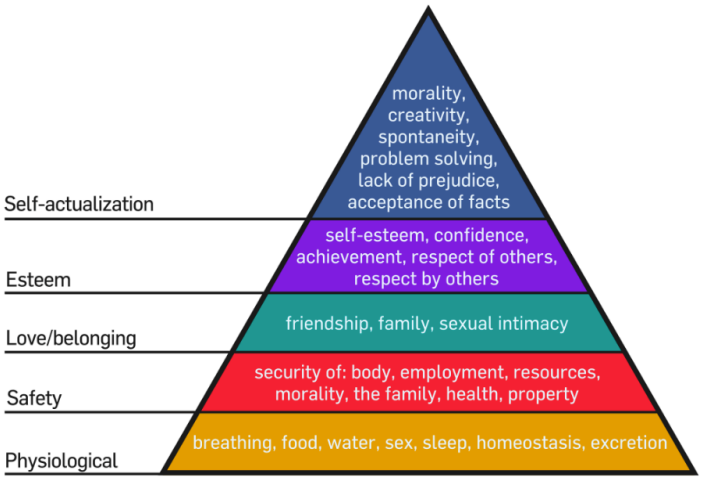

Fig 4.- Maslow's pyramid. [14]

Pyramid (Fig 4) shows the humans' social hierarchy needs. Social networks provide, in general terms, large doses of esteem and self-actualization to the user, the two terms in the top of the Maslow pyramid. [13] Thus, it is clear that social networks fill or refill two important terms for humans' needs, promoting the unprecedented boom of social networks.

2.1.2. Space: a social component.

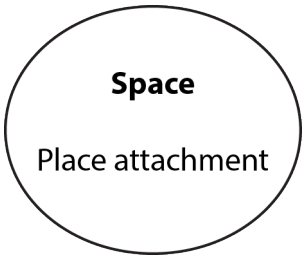

Fig 5.- Schema of Space's section content.

Place is simply a geographic area that has meaning to people [15]. The study of placed-based theories and research on sense of place, place attachment, place dependence and place identity have made a critical contribution articulating the roles and meanings that places have in our lives [16]. These concepts are broadly defined [17], [18], [19], [20]. Sense of place is described as *"an experiential process created by the setting, combined with what a*

person brings to it" [17]. Place attachment is considered *"the union of people to places"* [18]. Meanwhile, place dependence is understood as the strong bond between a person and specific places [19]. Finally, place identity has been defined as interaction of someone in relation to the physical environment [20]. Some argue that sense of place, place dependence and place identity are forms of place attachment.[16] From now on, when this dissertation refers to place attachment is involving the others four terms.

2.1.2.1. Place attachment

Place attachment to one's home and local area is beneficial [21]. As much as possible, any participation with residence's place is positive to create community outcomes. People with higher place attachment report greater social and political involvement in their communities [21]. Alternatively, they are more prone to successful teamwork [22] and to protect each other [21]. Moreover, high place attachment means better quality of life [22] and greater satisfaction with one's physical environment [23].

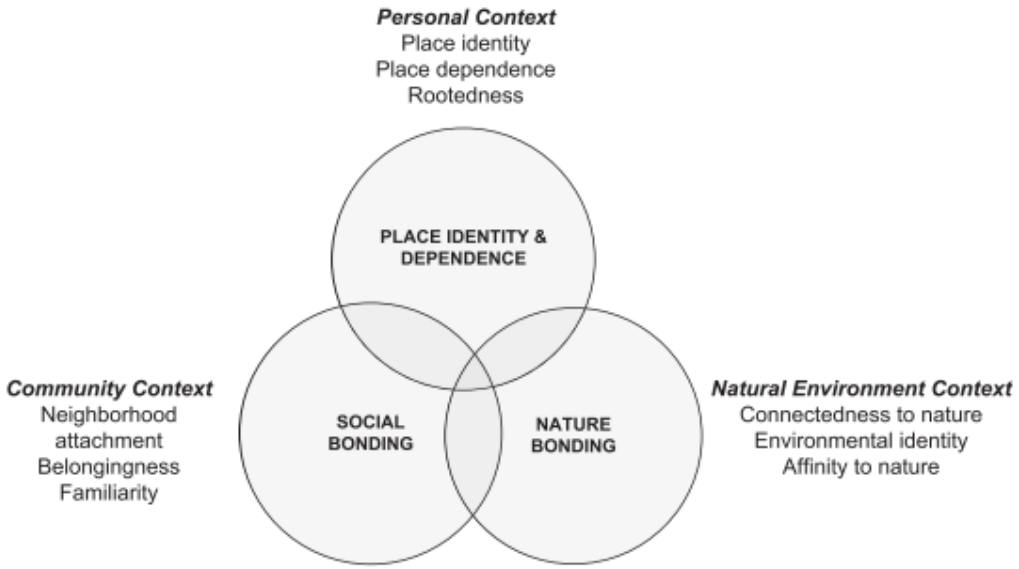

Fig 6.- Three-pole and four-dimensional conceptual model of place attachment. [24]

Fig 6, extracted from [24], shows a model of place attachment. Three poles overlapped in order to achieve a meaningful concept of place attachment compose this model. These three pillars are based on social psychology, environmental psychology and community sociology.

2.1.2.1.1. Place attachment in personal context

Different intensities of place attachment can be seen in personal context. These values depend on the degree of the relationship people-place, the size and the location of said place. Furthermore personal context depends on the interaction of someone in relation to the physical environment, the strength with the specific places and the roots established. Attachment to the place in a personal context can be predicted by certain social and

demographic factors. For example, it is stronger the feeling of belonging in a person who has bought a house than in another who is renting one [25]. But, what is the measure of this personal context? Studies have found that people give higher place attachment to their homes and surroundings than to their neighbourhoods. One possible explanation of these results could be that home is an easily definable space while neighbourhood is a broader concept [26]. As it was exposed above, Internet and social networks can strengthen the relationships of users in local areas in order to positively reassess neighbourhoods.

2.1.2.1.2. Place attachment in community context

The role of the community is an important input to create place attachment. The neighbourhood provides ideal scale for creating associations with diversity aims. As has already been pointed out, community attachment is strongly related to individual connections to local social networks (bonds) and the interactions between them. Kasarda and Janowitz [27] found that connections developed between people in a given place are more relevant than its population size or density.

There are two approaches to the concept of community in terms of space. First is the territorial and geographical notion of community. Second is the total number of residents and the connection between them without reference to location [27]. Gusfield [28], noted that both usages are not mutually exclusive. Modern societies with technological advances take less importance of people's location to create a community, putting emphasis to sharing common interests. Nevertheless, facing the unstoppable process of globalization and cultural homogenization, there is a growing interest in the local context. It is in this environment where the geographical notion of community makes sense, which may be a determining and very powerful factor.

2.1.2.1.3. Place attachment in natural environment context

Last pillar of the Fig 6 is the connection to the natural environment without human beings (nature bonding). There are three ways to include natural environment identity as place attachment: environmental identity, emotional affinity towards nature, and connectedness to nature. [24]

2.1.2.2. Dimension of place attachment and no-native inhabitants

Once the factors that take part in place attachment are exposed, the question is how to measure the dimension of place attachment. Some studies by Williams and colleagues [29] propose and validate 11 levels to evaluate and measure it. Among these levels, some are concerning nature bonding and social bonding, as proposed by Kyle et al. [30]. It seems that another logical approach to measure it are political and geographical boundaries, since there

is an inherent place attachment, result of living under the same delimitation and values. However, some of these boundaries are imposed, resulting from former political interests, historic events (war, treaties, etc.), geographic features, etc. which define the shape of countries, provinces, municipalities, etc.

Native or no-native nature in place attachment is studied deeply in a Hernández B. and colleagues' paper. [26] From this study they extract interesting results concluding that the importance of being born in the place you live, in terms to value the place attachment. The following sentences are extracted from results of the investigation:

- *"Results show that place attachment and place identity behave similarly in the case of natives born and raised in the same place but differently in the case of non-natives.*
- *Results also confirm that natives establish more intense links, whether of attachment or identity, with the island, the city and finally, with the neighbourhood where they live.*
- *Results show that neighbourhood lacks symbolism, while the city and particularly the island are heavily charged with content and relevant meaning. These results question the tradition of considering neighbourhood as the preferred place of attachment (Guest & Lee, 1983; Cuba & Hummon, 1993; Mannarini et al., 2006)."*

2.1.3. Inhabitants and collectives

Fig 7.- Schema of Inhabitants/collectives section content.

2.1.3.1. Inhabitants

The aim of this section is to list some opportunities and responsibilities that a responsible citizen must carry out in order to empower the relations and interactions of a given society. Bordieu [31] classifies between two kind of inhabitants: producers and consumers. Putting more weight of power in producers side. In contrast, Foucault [32] argues that power comes from everywhere. Producers or consumers, all of them are inhabitants and the public space is the meeting point where citizens interact with each other.

Inhabitant status represents a triple challenge to society, according to Borja, J. [33]:

1. Political challenge: preserves public policies that keep the rights of citizens.
2. Social challenge: promotes public policies that minimize the vulnerability of poor people.
3. (Only for urban environments): makes the city a producer of meaning to everyday life for citizens.

2.1.3.2. Collectives

In Section 2.1.2.1.2 the community was defined from the point of view of space. In this section, it takes a social approach. In social sciences, 'community' cannot deny its roots in German sociology of XIX century under the name "*Gemeinschaft*" and whose invention corresponds to Ferdinand Tönnies in 1887 [34]. While "*Gemeinschaft*" (community) is inspired in the model of family ties, based on inherited and objectified social positions and relationships of intimacy and trust, "*Gesellschaft*" (association) is related to an ideal type of society based on impersonal relationships between strangers with independent links. It is accepted that the relationship between these concepts allowed society to evolve from a society based on kinship to one focused on contract and individual rights. This statement has different interpretations depending on the author's point of view; while Tönnies regards "*to feel the same thing*" as "*having the same feelings*"[35], Durkheim interprets it as sharing the same sensations [36].

In order to distinguish between common and collective we must consider the study of Maurice Halbwachs [37]. A common memory is identical for all the members of certain society, while in a collective memory all members are articulating the distinct contribution, assuming distinct memories as well. The term 'community', based on common, is presented as a unique social body severely hierarchical that encloses its components in an organizational order. Nevertheless 'collective' term is associated with the idea of reaching an agreement that benefits all members, to achieve certain goal.

2.1.3.3. Participation

Schlossberg and Shuford [38] define 'public' as those affected by a decision or program, who can bring important knowledge and who have power to influence the implementation. Relevant studies have addressed the complexity of participatory processes [39]–[41] giving more weight to participatory processes from top to bottom. Conversely, some studies in rural areas are focusing on how indigenous communities have articulated their participative process [42] [43], showing another kind of more decentralized participation. Horizontal processes where each inhabitant or collective can ask for participation to the others [42]. If the participatory process is well documented and communicated, each of the actors can give

a meaningful opinion and know the others' vision [44]. Internet offers new channels of communication and organization that could enable true direct participation. The Network has allowed a degree of organization and citizen cooperation that goes far ahead of the modernization capacity of governmental organizations.

2.1.3.4. Participation and Geographic Information System

Citizens handle a lot of information in their daily life, which includes complaints and opinions about their country, city/town or neighbourhood [45]. A big amount of tangible and intangible items in a city are available to be located in a position at a given time. This can be extrapolated to a multitude of areas and the resulting information can be analysed and visualized in a spatial way [46]. The demand of ubiquitous spatial applications is growing exponentially within all sectors of society [47]. But, how can GIS be involved in this participatory process? In 1996, a new discipline appeared: PPGIS. The following definition describes this topic: *"Public Participation Geographic Information Systems (PPGIS) belong to the use of Geographic Information Systems (GIS) to broaden public involvement in policymaking as well as to the value of GIS to promote the goals of nongovernmental organizations, grassroots groups, and community-based organizations."* [48] From this definition, the main idea to be drawn is how PPGIS can extend and enforce public participation in order to be able to go along the generation of new policymaking approaches and strengthen the bonds of social organizations. Recognition that GIS can be a social technology implies that the GIS research agenda should be broadened to incorporate questions of the social site [49]. In certain ways, GIS is a good logic instrumental interlocutor for social science. The mapping of results and possibility to insert data to the map add another possibility to the user to interact with the process.

2.1.3.4.1. Volunteered geographic information, Participatory GIS and Public participation GIS

Nowadays, there are three important methodologies that merge participation and geographic information: VGI, PGIS and PPGIS. The difference between these three concepts is ambiguous, as researchers do not agree on the use between them [3]. Table 1 sums the characteristics of the three concepts, according to the point of view of Greg Brown and Marketta Kyttä [3]. As exposed before, the difference between them is still unclear, as this table includes generalization of concept's uses, which are subject to exceptions.

	PPGIS	PGIS	VGI
Process emphasis	Enhance public involvement to inform land use planning and management	Community empowerment Foster social identity Build social capital	Expand spatial information using citizens as sensors
Sponsors	Government planning agencies	NGOs	NGOs, ad hoc groups, individuals
Global context	*Developed* countries	*Developing* countries	Variable
Place context	Urban and regional	Rural	Variable
Importance of mapped data quality	Primary	Secondary	Primary
Sampling approach	Active: probability	Active: purposive	Passive: voluntary
Data collection	Individual (e.g., household sampling)	Collective (e.g., community workshops)	Individual
Data ownership	Sponsors of the process	People and communities that created data	Shared (e.g., data commons license)
Dominant mapping technology	Digital	Non-digital	Digital

Table 1.- Characteristics of PPGIS, PGIS and VGI. [3]

PPGIS are associated to developed countries and to enhancing public involvement to inform land use planning and management; while PGIS are used as a development tool in developing countries to achieve community empowerment and the creation of social capital. In many cases PGIS advocates more participation component than resulting maps. PPGIS also take care about social capital and enhancing community, albeit they regard it as secondary concepts. VGI typically uses citizen-initiated convenience sampling methods that generate individual mapping contributions [3]. VGI is closely related with "crowdsourcing" [50] and it is favoured by the increase of mapping applications.

Schlossberg and Shufford [38] note that "public" term in PPGIS is depending on its own definition. It may include "decision makers", "affected individuals", or the "random public", among other groups. From this broad perspective, it makes sense not only to see GIS as a container of maps, if not as a tool to spatial decision-making [51], even more, as a provider of otherwise invisible or intangible geographical information [52].

Studies done by G. Brown et al. [3] demonstrate that participation rates in surveys have declining response rates in all methods. Internet-based methods, however, show 11% less responses rates than conventional modes. Moreover, comparing PPGIS web mode with paper mode, the rate is 2.5 times higher for the paper-based method. PPGIS was well received for those who saw the potential to gather knowledge from citizen experience, although there is still a big challenge in capturing the interest of lay people in participatory processes.

2.1.3.4.2. SoftGIS

"*The descriptive term **"soft"** refers to the subjective and qualitative nature of the mapped attributes as a contrast to the **"hard"** spatial data layers usually associated with GIS.*"[3] Furthermore, soft knowledge is based on people's personal experiences, configuring a place with attributes coming from the memories, meanings and values of its inhabitants. SoftGIS methodology represents an improvement over PPGIS, as it enables to collect large data with user-friendly applications from citizens or groups of them. However, location-based approaches tend not to consider person environmental studies, neither within the social sciences tradition nor in environmental psychology studies. On the other hand, in Geography

takes places as the core of the discipline [1]. In order to confirm this point of view, it was introduced in previous sections the study of Lewicka [25] in which the focus of the revision is the person component instead the place or process components.

Map-based questionnaires [53] can be a suitable method to enhance and empower community organizations and stakeholders, further opening a way to create participatory processes by community organizations to enhance policy affairs. When citizen and stakeholders are motivated government intervention is needless. Resulting data from SoftGIS provides information that is not normally available. *"Knowledge of the residents' perceived quality and use of their living environment is particularly needed"* [54]. Even more, it seems that planning processes are not prepared to incorporate this knowledge [55]. In fact, this is the motivation to develop SoftGIS; to fill the gap in planning process of perception and feelings of inhabitants. "*This soft knowledge has been gathered and studied extensively, but it has not been systematically attached to places*." [54]

2.1.4. Relation between Internet and Space

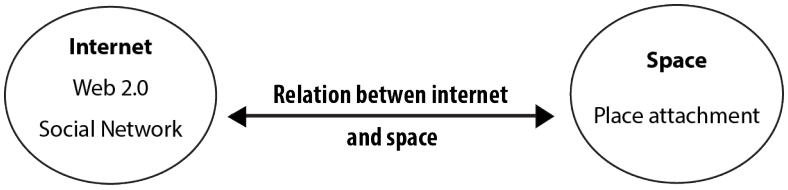

Fig 8.- Schema of the relation between Internet and space

The irruption of technology in public spaces is changing the model of the society. In the past, emotional relationships were developed in a constant and close space (neighbourhood, cities, etc.) while nowadays they are also developed in a virtual space such as social networks. Internet is certainly one of the most extraordinary achievements of new technologies and its ability to complement the conventional public space must be considered.

The idea of global and globalization is a reality. However in opposition to this ideal, it also persists the resistance of the local space, where people's experience is closer and face-to-face. Local uses of the Internet have shown to support the revitalization of local environment where they thrive. Therefore, a greater use of the Internet and the development of a digital culture is taking people out on the streets and bringing back many of the uses of the streets and the city [56].

On the other hand, virtual space is simulating public space like communication place, even though this virtual space, provided by the Internet, is growing stronger, people still identify their attachment with physic space [57]. Internet provides the tools to connect one local public space to others, forming a network of public spaces and feed on this connection.

2.1.5. Relation between Internet and Inhabitants/Collectives

Fig 9.- Schema of the relation between Internet and inhabitants/collectives

2.1.5.1. Government

ICT are allowing specialized and general local/public spaces of dialogue, of different rank and size. And the new way of doing politics may be in the hands of these new public spaces. Though it involves new technology, Government 2.0 is really about a new approach to governance [58]. Nowadays it is possible to make processes more transparent with immediate participation. Surely, this is political leaders' new main challenge in order to achieve democracy 2.0 or E-democracy [59].

2.1.5.2. Citizen

Giovanni Sartori [60] argued in 1998 that we are in front of a genetic mutation, Homo sapiens, product of literacy, is being transformed into "homo videns" to whom the word has been dethroned by the image. According with this point of view, William Deresiewicz [61] thinks that the appearance of the camera has created a culture of celebrities and computers, a culture of connectivity. And Web 2.0 has enabled the convergence between them. For example, social networks merge both cultures: celebrities and connectivity. Thus, interaction allows individuals to be known, and it seems to be contemporary human's main goal: " to be visible" [61].

2.1.5.3. Collectives

Technology itself can re-humanize social relationships [62]. New tools and channels of communication are awakening new consciences and collective values. If it is true and there is a strong local community recovered, new global consciences empower local collectives, thus providing several opportunities.

2.1.6. Relation between Space and Inhabitants/Collectives

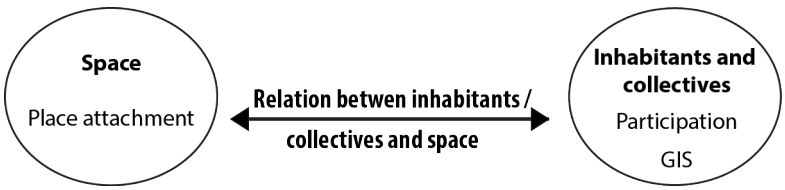

Fig 10.- Schema of the relation between space and inhabitants/collectives

A place is just a geographic area that has meaning to people [15], while inhabitants and collectives are the settlers of this place. In this relationship, technology can act in two directions, depending on how society uses it; on one hand it can cause offshoring, and on the other side it can also enable local approach a leading role. Internet's nature is connecting people around the world. At the same time it can strengthen local and community relationships by sharing content. This philosophy, focused on collective participation, free access and freedom of use has given birth to a new type of more supportive and generous "society", where any professional can share knowledge, seeking to serve the common good. Periphery is no longer a geographical issue and has become almost a matter of attitude [63], where Internet plays a crucial role.

2.2. Similar applications

During the last few years, the number of social opinion applications has increased, thanks, in part, to the necessity for immediate communication and opinion by citizenship.

This section contains a brief description of some mobile and web applications. Section is divided in two parts: on one side there is a list of question based applications and on the other side, it is exposed some applications that ask for users support in social initiatives.

2.2.1. Question based applications

It is possible to distinguish between two different application formats; while some allow to create a unidirectional form in order to get answers for market research, others seek a two-way interaction, thus showing more concern about the users' point of view and enabling the sharing of information.

The ones presented in this list are applications of the second group. These platforms have appeared last years responding to the need of a channel through which people can express their opinion. Most of these applications are unknown to the general public, but in the coming years they have the potential to become a very useful tool. For each application there is a short description about its functions, the kind of interaction it enables with user and some relevant information.

Appgree

Appgree[5] (Fig 11) is a web and mobile app that allows a different range of the population to communicate more easily. Its communication is bidirectional, but is always started by the site of the owner of the channel. Nowadays, Appgree is the most widespread application of the list because its easy way to merge hundreds or thousand voices into one and its flexibility

[5] https://app.appgree.com/ [accessed December 26th, 2014]

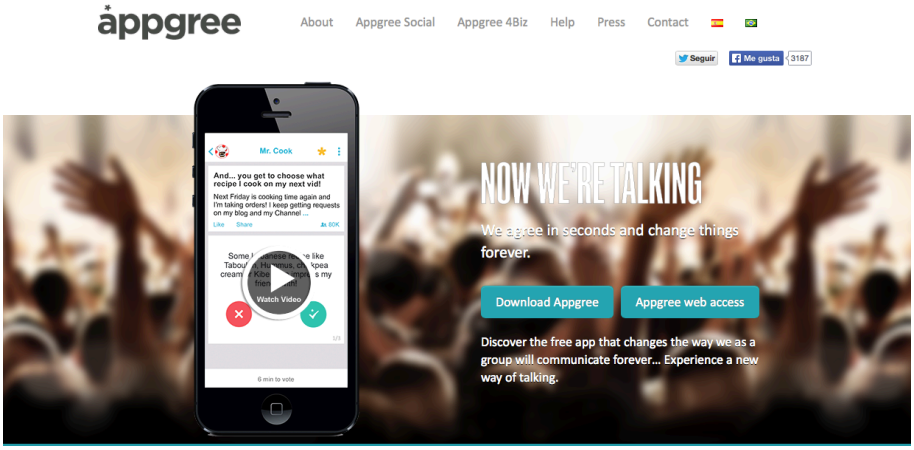

Fig 11.- Main web page of Appgree.

to create new interactions. It uses a breaking algorithm to analyse the opinion of a given amount of people and provide the most popular answer. This algorithm becomes more robust as more people respond. There are many channels available about different topics and some relevant political parties and enterprises are starting to use it to communicate with their users.

QueryDay

QueryDay[6] (Fig 12) is a mobile application that allows users to state their opinion through social voting. This application is the most similar to a social network from the list. Users can vote and comment on thousands of close questions, get real time opinions from their friends or the ones polled and get geolocated answers. QueryDay lets users interact with the system as a single anonymous user and sort questions by subject.

Fig 12.- Main web page of QueryDay

[6] http://www.queryday.com/en/ [accessed December 26th, 2014]

Your OPinion Platform(Yopp)

Yopp[7] (Fig 13) is a mobile platform where users can give their opinion in shared form that includes the other users' opinions. This resourceful app enables users' responses to be sent to decision-makers, whether in a neighbourhood, city or country scope, or their opinion groups. There is a two-way interaction; users can propose new questions for any group, public or private. Once the question is answered, the user is able to see the statistics of the responses. Users' opinions are anonymous and through them, a picture of user environment can be easily developed. Yopp allows the creation of groups (public or private) by users, while establishing a stable communication between government and citizens.

Fig 13.- Main web page of Your OPinion Platform (Yopp).

Safety GPS

SafetyGPS[8] (Fig 14) is a mobile platform for exchanging information and geographic location between entities and users. Any registered user can post a safety (message text, picture and position) to any entity registered on the platform. These safeties' functionalities are very broad: from reporting urban damage or abandoned vehicles to sending segmented notifications, sorted by topics, to any organization, or contact them on an emergency. Being a faster channel of communication than through conventional ones. In addition, users can read quickly and safely alerts sent by governmental organizations, for instance in the event of a natural disaster. SafetyGPS is the first platform that allows emergency communication with organizations that is 100% accessible to people with hearing and other disabilities.

This is only a selection of applications currently available that are similar to parts of this dissertation's application. In Table 2 can be seen a comparative study of the different

[7] http://youropinionplatform.net/index_es.php [accessed December 26th, 2014]
[8] http://safetygps.com [accessed December 26th, 2014]

functionalities and main characteristics of the applications described above. This comparative is done by user perspective. Table 2 shows the main features and allows the reader to see the strengths and weaknesses of each application. At first glance, it is representative that none of them allow users to download the results of their own questions or safeties.

Fig 14.- Main mobile page of SafetyGPS.

Also, users cannot state their background, questioners cannot decide who they want to answer the questions, and there is no filter to set a geographical limit to send or receive notifications. Besides, none of the applications allow users to filter questions in order receive them sorted by topic. Queryday has the possibility to add a topic to the question, but when another follows a user, he or she receives all the questions created by the other user, in a similar way to Facebook[4] notifications.

All the applications have representation in mobile platform and only Appgree can run in a computer with the same functionalities than mobile version. The geographic component for both sending and receiving questions, is present in some applications. While Yopp takes into account the geographical component to suggest groups and even to choose the interface language, Queryday shows the user a map segregating the answers by province limits, being this political limit the maximum scale of detail.

		Appgree	QueryDay	Yopp	SafetyGPS
Available platform	Mobile App	☒	☒	☒	☒
	Web Platform	☒			
	Global distribution	☒	☒	☒	
General functionalities	Questions/group filter			☒	
	Two-way free interaction		☒	☒	☒
	Create groups	☒		☒	
	Query/user search		☒		
	Geographic group suggestion			☒	☒
User capabilities	Anonymous user		☒	☒	
	Users interaction	☒	☒		☒
	Available actions according user position			☒	
Questions and answers	Open questions	☒			
	Share contents		☒	☒	☒
	Comment content		☒		☒
	Filter questions to receive				
Results	Open Results	☒	☒	☒	
	Real time Results		☒	☒	
	Download Results				
	Segregate Results		☒		
	Geographic Results		☒		
Subjective impression	Easy interface	☒	☒		

Table 2.- Comparative study of question based applications.

2.2.2. Support based applications

These platforms have appeared also during the last year, responding to the need to connect people in order to achieve a better world. The operation of the application is similar in all the applications of this kind. Citizens or a collective initiates an action to change something and the other users can support the initiative by signing the petition. Users or collective can also declare the minimum amount of signatures for the success and they can attach the addressee to whom the petition is directed.

Unlike last section, this one does not present a list with a short description of each application because their functionalities and procedure are very similar. Instead, there is a comparative table to show the main features, allowing the reader to see the strengths and weaknesses of each application. There are few applications that enable users to support initiatives for social change. Surely, change.org[9] is the most famous and widespread around the world, followed, certainly, by care2[10]. These two applications are the most important social change petition-based applications. In Table 3 there is a comparative study of the different functionalities and main characteristics of change.org and care2. For the aim of this dissertation it is very surprising that none of them have taken the geographical component into account, neither in sharing petitions nor in filtering them. It is not possible to know who has signed the petition and only the petition's owner has this privilege. As it would seem logical, it is not possible to sign any initiative as an anonymous user. Finally, change.org do not enable users to filter petitions neither by subject nor by delimitation, while in care2 subjects can be filtered. For instance, in order to find some petition related to your municipality you have to find manually the municipality's name that appears in the heading of the petition, if it appears.

[9] https://www.change.org [accessed December 26th, 2014]
[10] http://www.care2.com [accessed December 26th, 2014]

		Change.org	Care2
Available platform	Mobile App		☒
	Web Platform	☒	☒
	Global distribution	☒	☒
Doing petition	Subject notation		☒
	Sharing Facebook/twitter	☒	☒
	Sharing by email	☒	☒
	Sharing by geographical limit		
User capabilities	Anonymous user		
	Users interaction	☒	☒
	Available petition according users' position		
Searching petition	Filter by location		
	Filter by subject		☒
Signing a petition	Comment signature	☒	☒
	Real time Results	☒	☒
	Download Results		
Subjective impression(*)	Easy interface	☒	☒

Table 3.- Comparative study of support based applications.

The application described has the possibility to engage citizens in PPGIS or PGIS processes (see Section 3.5.3.5). These kinds of practices are typical from government or, in less measure, associations. For example, there are few cases of this nature in Spain using Internet technologies, moreover they are isolated and almost all cases are created by city councils in planning policy-making. This dissertation's application provides to any collective registered, the possibility to create participative processes and send wherever, generating discussion and new points of view.

This chapter shows how there is still big room for improving different aspects like the interaction between inhabitants and collectives, easy access, performance, etc. There is an important lack of geographical features in all the last section's applications, which share their content only in social networks and through mailing. Besides implementing more functionalities, the application described in this dissertation aims to fill the gaps in Table 2 and Table 3, understanding that geographical filtering, accessible data and sorting of information according to your interests, must be very important features for an application of this nature.

2.3. Study Cases

Final part of the chapter is related with two study cases. As it was shown in Section 2.2, it is still big room for improvement in different aspects of the current applications of this thematic. Overall, this dissertation's main goal is to insert geographical component to an application of this nature, and, in fact, the aim of this section is to show some cases where the spatial component has been forgotten and why it is crucial to attend to this matter. There is an important lack of geographic component in applications showed, understanding that geographical filtering must be an essential and very useful tool to movement for social change.

In order to prove how spatial tools can help and optimize this kind of applications, there is here exposed one case extracted form change.org. It covers an issue in a municipality (La Garriga, Catalonia, Spain) with the aim to change something thanks to support from users. Furthermore, there is an example of a political party willing to prove their transparency in Barcelona: Guanyem[11]. Finally, the last section of this chapter introduces some hypothetical case where application described in this document can help different users.

[11] https://guanyembarcelona.cat [accessed December 26th, 2014]

2.3.1. Picnic area case

Bordalla[12] Association is an assembly of young people in La Garriga that started an initiative on 24th November 2014 against the construction of a picnic area in the municipality of Cànoves-Samalús. The council of Cànoves-Samalús approved a project for a picnic area in a rural environment, which affected neighbouring towns such as La Garriga, since to arrive to the picnic area it is mandatory to pass through this town. The initiative wanted to collect signatures to pressure Cànoves-Samalús' council to give up this idea. In general terms, Bordalla's reasons to create this initiative are the risk of fire, destruction of the landscape and project deficiencies on the sewage system.

Fig 15.- Image of picnic area project and suuroundings

By the time this dissertation has been written (January 2015), the initiative has achieved 490 signatures distributed in 134 different areas.

Fig 16 shows the participation among representative municipalities. There are 134 areas involved in the petition and this 8 representative municipalities represent around 66,50% of the total signatures. The other components of the list do not exceed 3 votes, being 89 areas with one vote. At first glance, it is very surprising the percentage of votes from La Garriga (53,06%). This issue can be a result of the arguments exposed before, or due to the fact that Bordalla is an association based in La Garriga. The second higher value in the chart is Barcelona with 31 signatures (6,33%); it is not surprising, since Barcelona has more population than the rest of the municipalities, but focusing on what amount of people represents this percentage for Barcelona (right column), percentage of signing population is the lowest of the figure. The rest of the items are municipalities from the same *comarca* -

[12] http://assemblealabordalla.blogspot.com.es [accessed January 16th, 2015]

county- (Vallès Oriental) where the picnic project area is located. As an anecdote, there is one vote from New York and another from United Kingdom (UK) being the only two signatures from outside Spain, demonstrating the internationality of change.org.

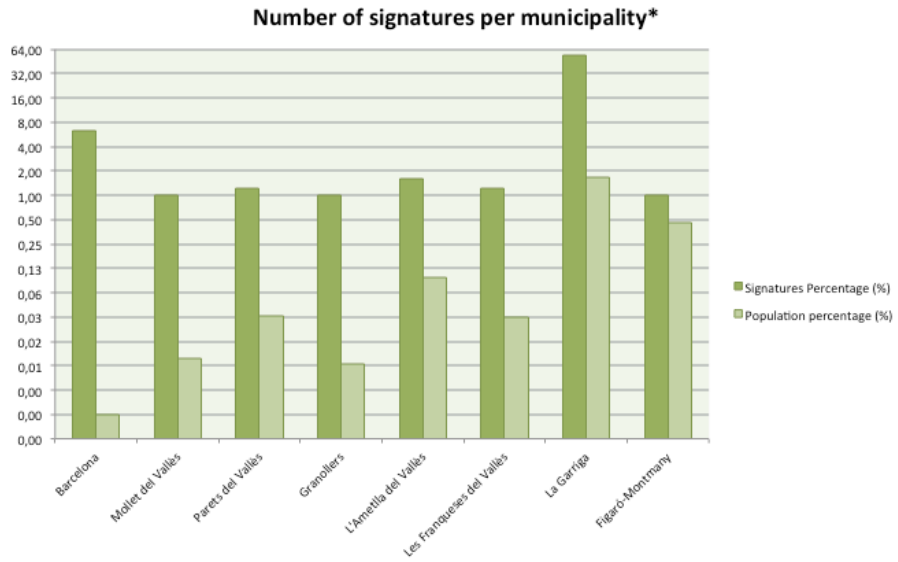

Fig 16.- Percentage of signatures per municipality (*) representative municipalities.

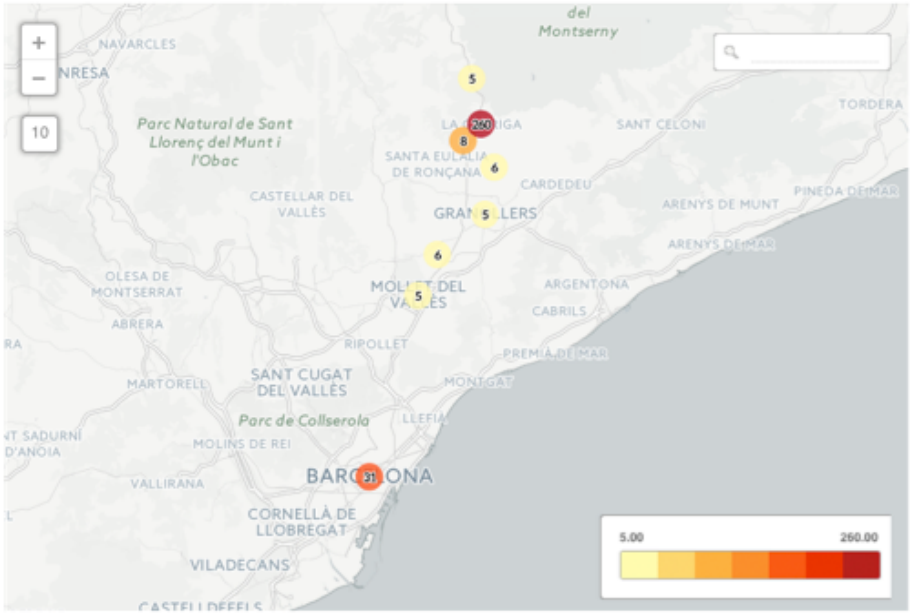

Fig 17.- Spatial distribution of Figure 16

Fig 17 represents spatial distribution of these 8 municipalities; only Barcelona is outside the *comarca* of Vallès Oriental. This map illustrates that the participation increases as the distance from the place decreases. From the eight highest values from the list (66,50% of the total), 57,95% are neighbouring towns, while 60,20% are municipalities from the same *comarca* (Vallès Oriental). Future work can be lead to find out which percentage of

Barcelona's voters was born in La Garriga or are bonded with the town.

Attending to the percentages, it is possible to see that it would make sense to implement a new functionality in change.org in order to enable petitions to be sent to certain geographic limits, to increase diffusion. This new functionality does not need to replace the current methods of sharing petitions through social networks and mailing list, but it can be regarded as another channel to spread the petitions. As seen in the example above, it would represent, at least for local issues, a useful new feature.

2.3.2. Guanyem's case

Guanyem[11] is a new political party that is going to run in the upcoming municipal elections (May 24th 2015) for the city council of Barcelona.

In July 14th 2014 the following headline appeared in a newspaper[13]:

" "Guanyem" quiere ganar los barrios preguntándoles."

" "Guanyem" wants to win the neighbourhoods by asking them."

In order to achieve this proposal Guanyem used Appgree as a participation channel. In Section 2.2 the characteristics of this application were reviewed and the lack of the spatial component was pointed. Moreover, Guanyem understood that the decentralization of power is essential in order to achieve a better management and thus, there are created commissions in all the neighbourhoods of Barcelona that deal with local problems and advocated for participation, diffusion, transparency and collaboration.

The application described in this dissertation also regards decentralization and local management as essential to understanding better local social problems. (see Fig 22) The application described can provide the spatial component to Guanyem's vision in order to understand opinions and problems at district level, instead of just having a general overview. Furthermore, Appgree channels are public and users from anywhere can enter the *Guanyem Barcelona* channel and give their opinion and send their answers through the channel. Then, a question appears: does it make sense to take into account the votes of citizens outside Barcelona in policy-making affairs? It is not an answer with easy solution, but at least it is a question to consider.

[13] http://www.diariounidad.es/index.php?option=com_content&view=article&id=321:guanyem-barcelona-aterriza-en-los-barrios-para-ganar-preguntando&catid=88&Itemid=573 [accessed January 16th, 2015]

3. Application design and implementation

This section describes all the technologies used to deploy the application and the scope of the application implemented. Once the fieldwork is justified, technology part of the chapter starts with the architecture design of the application, the second part focuses on webGIS technologies used to set up the application. Then, there is described the source and the pre-processing applied to the data and finally, a description of the functionalities and components of both designed and implemented application.

3.1. Scenario description

The extent of the study area is the country of Spain. The Spanish population always have had a strong social feeling regarding injustice and labour rights. It is the fifth country in the world that has undergone more strikes and lockouts, between Russia and Australia.[14] Several citizen movements such as Democracia Real Ya (DRY)[15], 15M Movement[16], etc. appeared in recent years with the aim to achieve more transparency, better participation processes and real democracy. Social movements and specially Spanish citizens are becoming aware of the importance of their role in society and of being proactive.

Many people follow these collectives (DRY and 15M) and their message is widespread around the world. 15M first started as a strong demonstration that "camped" on many central squares throughout several Spanish cities. Then, the movement became more local and was reorganized in towns and neighbourhoods to treat problems locally by interacting with the people, a behaviour far away from what Spaniards are used to from the current political parties in Spain. The rise of these new collectives had two direct consequences on Spanish politics: on one hand, an attempt to change by the main parties, in order to become more transparent and participative; and on the other hand, new political parties emerged into the Spanish political scenario, such as Podemos[17] (in case of Catalonia, Guanyem[11]) and to tried to fulfil these deficiencies. These last two parties are introducing new participation approaches, in order to acknowledge the opinion and the voice of the people. Recently, in January 26th 2015, on the Greek elections a new major party was elected: Syriza[18]. The fourth pillar of its electoral program was related to improving democracy, strengthening transparency and engaging participation, among others. Many people view similarities between Syriza and Podemos. This last is obtaining great results in the voting intentions

[14]http://www.mapsofworld.com/world-top-ten.html[accessed December 26th, 2014]
[15] http://www.democraciarealya.es [accessed December 26th, 2014]
[16] http://www.movimiento15m.org [accessed December 26th, 2014]
[17] http://podemos.info [accessed December 26th, 2014]
[18] http://syriza.net.gr/index.php/en/ [accessed December 26th, 2014]

surveys in Spain, positioning the political party as the first or second most voted for upcoming general elections. If the tendency follows and Podemos has the chance to rule the country, according to their principles it can be an indicator that something is changing. Or at least, that there is a change of roles, where the people's voice has become more important.

Besides, other reasons for choosing this area is the author's familiarity with it and the availability of its political administrative boundaries for the application. Furthermore, there are some social factors that also make it interesting to develop the application in this area:

- Associative networking is widespread and active throughout the country
- Spain is part of Open Government Partnership (OGP): "*An international platform for domestic reformers committed to making their governments more open, accountable, and responsive to citizens*". [19]

3.1.1. Official administrative boundaries of Spain

Fig 18.- Study Area (dark green)[20]

Spain has five official administrative boundaries: province, autonomous community, municipality, districts and census section. It is interesting to know a bit about each delimitation, in order to better understand geographical filtering.

- **Autonomous community** is a first political and administrative division in Spain. It has certain legislative autonomy and certain executive and administrative powers.

[19] http://www.opengovpartnership.org [accessed January 10th, 2015]
[20] http://es.wikipedia.org/wiki/España [accessed January 16th, 2015]

The structure of Spain in autonomous communities is reflected in the Spanish Constitution of 1978. In Spain there are 19 autonomous communities.

- **Province** is a territorial division of Spain under autonomous community, recognized in the Spanish Constitution of 1978 but set in 1833. In Spain there are a total of 50 provinces, and together with the autonomous cities of Ceuta and Melilla, they comprise the entire Spanish territory.
- **Municipality** is the basic level of Spanish local government. There are 8119 municipalities in Spain.
- **District** in Spain is an administrative subdivision of municipality.
- **Census section** is the minimum partition of municipality and the basic delimitation for democratic votes process. It is characterized by:
    - Preferably defined by easily identifiable boundaries such as natural terrain features, permanent buildings and roads
    - Has a size between 1.000 and 2.500 residents.

All of these official delimitations of entire Spain are available in the application. There is another unofficial delimitation between province and municipality called "comarca" (similar to *counties*). There are some "comarca" councils with some degree of power, for instance in Catalonia.

This application takes the entire principal, administrative and political boundaries of Spain. Also it is possible to select the whole country in order to send a question. As pointed out by Williams and colleagues [29], it is a process that seeks to determine the limit of place attachment. This application wants to be very flexible in defining spatial component for each user and action. Thus, this application takes care of this issue and allows users define limits of their action, jumping administrative barriers if needed.

3.2. Architecture

The Architecture concerned to this application is multi-layer architecture. The most widespread use is the three-layer architecture: presentation layer, server layer and data layer. These three layers are physically separated, letting development to be carried out at various levels. If any change is made, it is only revised on the required level.

Presentation layer / User layer.

It is the layer that connects users with the system. The presentation/user layer presents the system to users and gathers information. It should be user-friendly. This layer organizes the communication between users and the system services.

Server layer

It contains the services and controls the application's functionality by performing detailed processing. The server layer is located between the presentation and data layers, receiving users' petitions and answering before processing them. In it are stipulated all the rules that application has to accomplish for.

Data layer

It is where data resides and where it is manipulated. It consists of one or more database managers performing all data storage, receiving requests for storage and retrieval of information from server layer.

These three layers are connected with the structure and the components of the application (see Fig 19).

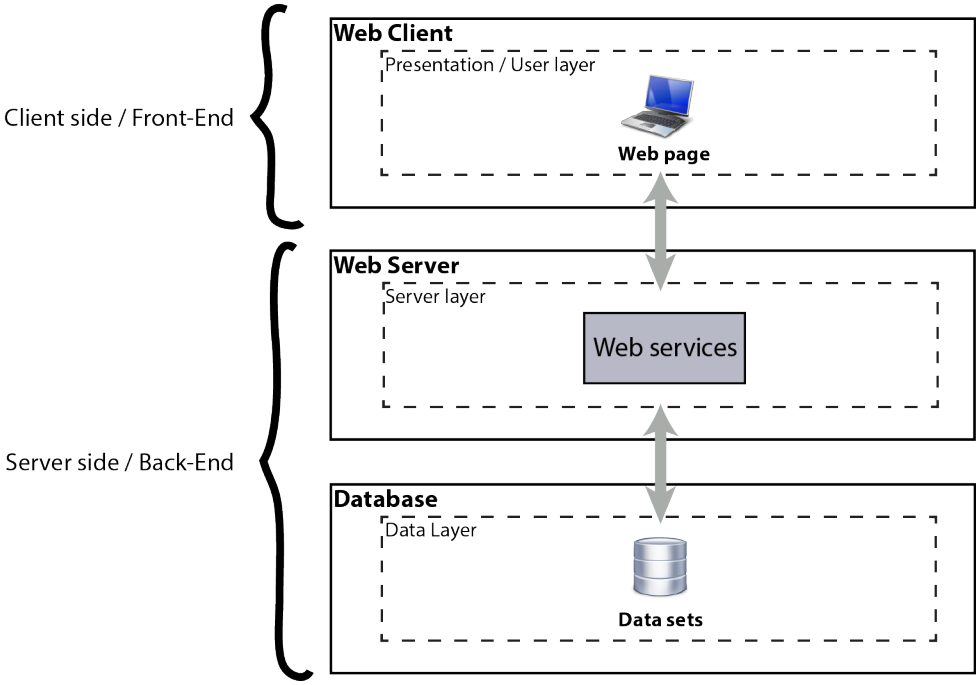

Fig 19.- Schema of the application's architecture

3.3. WebGIS Technologies

GIS made a giant step with the introduction of Internet and Web 2.0, and subsequent consolidation of WebGIS. It is based on four components: computer hardware, computer software, data and liveware. Irruption of Internet permits to separate these components in different locations. Fu and Sun [64] define WebGIs, in general terms, as a GIS that uses web technology.

3.3.1. Server and Client Sides

A Web application runs partly in the client's part (front-end) and partly in a server side (back-end). The client's side refers to web browser where users interact with the application and server side indicates all components that are behind front-end, hosting it (web server and database). Fig 20 shows the different technologies used for each part.

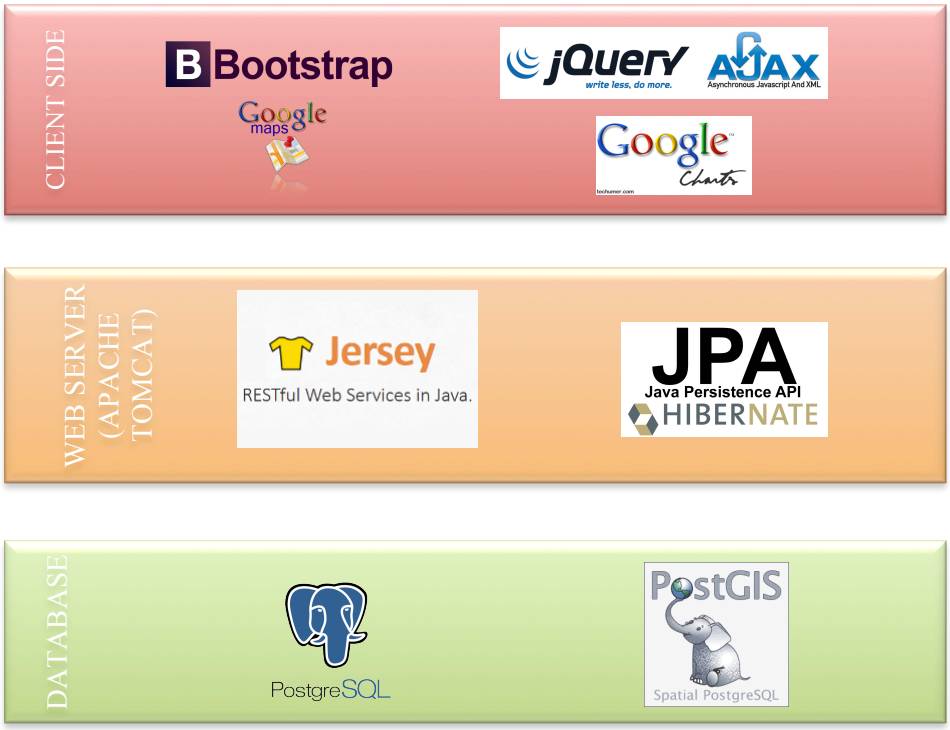

Fig 20.- Schema of all the components and tecnologies related

3.3.1.1. Client side

Client technologies permit the communication between users and servers, manage user events, requests to the server and adjust HTML documents based on the server responses. Client-side scripting enables interaction within a webpage. The code required to process user-input is downloaded and compiled by the browser or plug-in.

3.3.1.1.1. HTML, CSS and JavaScript

Hypertext Markup Language (HTML) is the main computer language devised to create websites and the basic structure for web technologies. The language is basically plain text that defines the context using tags (markup) to create a webpage in a structured format. World Wide Web Consortium (W3C)[21] is the organisation in charge of designing and maintaining the language.

[21] http://www.w3.org [accessed January 12th, 2015]

Cascading Style Sheets (CSS) is a style sheet language used for describing the look and formatting of a document written in markup language. The main advantage of CSS over presentational HTML markup is that the styling can be kept entirely separate from the content. It is possible work only in HTML context in order to manage the website's appearance, but CSS, supported by all browsers, is the best way to control the presentation layer in a web document.

JavaScript is a programming language used to make web pages interactive, interpreted directly by the browser. JavaScript code can be imbedded in HTML pages and interpreted by the Web browser. JavaScript can also be run at the server. Thus the client can perform many of the roles done previously only by the server, providing a higher degree of interactivity to the application. JavaScript code is nowadays responsible of the application initialization and interface definition. To complement JavaScript there is a group of interrelated web development techniques used on the client side to create asynchronous web applications: AJAX (Asynchronous JavaScript and XML). AJAX is a technique for creating fast and dynamic web pages. It is a method of building interactive Web applications that process user requests immediately. However, unlike HTML, with AJAX parts of a web page can be updated, without reloading the whole page.

3.3.1.1.1.1. Bootstrap

Bootstrap[22] is a framework originally created by Twitter, which lets you to create web interfaces with CSS and JavaScript. It is able to adapt the website interface depending on the size of the device in which it is displayed. This technique of design is known as responsive design or adaptive design. The learning curve is gentle and the documentation is very complete. Bootstrap's responsiveness was the main reason to choose this framework, in order to cover different technological devices. There are alternatives to Twitter Bootstrap, such as Web Starter Kit[23] (Google), Foundation[24], Pure[25], etc. Nowadays, Bootstrap is the most famous of them; there are many resources in forums and reusable snippets.

3.3.1.1.1.2. JQuery

JQuery[26] is a free Javascript library and one of the most popular, which works in all modern browsers. It has become a common complement in most websites. jQuery allows the user to make HTML traversal, event handling, animations and works with AJAX. The learning curve is gentle and the documentation is very complete. Nowadays, there are real

[22] http://getbootstrap.com [accessed January 13th, 2015]
[23] https://developers.google.com/web/starter-kit/ [accessed January 13th, 2015]
[24] http://foundation.zurb.com [accessed January 13th, 2015]
[25] http://purecss.io [accessed January 13th, 2015]
[26] http://jquery.com [accessed January 13th, 2015]

alternatives to jQuery like AngularJS[27], but the reasons to choose jQuery are that the Javascript part behind Bootstrap works with jQuery and that the learning curve is more gentle in jQquery than AngularJS. Furthermore, integration to use AJAX in jQuery is very intuitive and easy to use.

3.3.1.1.2. Maps and data visualization

In order to cover all the features that are interacting with the application through a map and visualization, it is chosen Google Maps API V3 and Google Charts, respectively. This is due to the easy learning curve that Google resources offer. There are a lot of alternatives and some are very powerful, in the following sections this choice is defended and compared.

3.3.1.1.2.1. Google API V3

Google API V3[28] is probably one of most famous mapping services, mainly because it is one of the first public APIs created. It is well documented, available in different languages and easy to use. The API provides a number of utilities for manipulating maps and adding maps' content through a variety the services[29], allowing the user to create robust maps applications on their website or mobile application. Google Maps' API allows to introduce Google Maps in webpages, albeit with some restrictions. Contrary to OpenLayers or Leaflet, Google Maps has some rules to make a proper use of the API. Google Maps V3 API is not allowed to use when:

- "*The site is only available to paying customers.*
- *The site is only accessible within a company or in an intranet.*
- *The application relates to enterprise dispatch, fleet management, business asset tracking, or similar applications.*"[30]

It also has some restrictions in services provided by Google Maps, giving a maximum amount of use for each service. For the academic application concerned in this dissertation, these restrictions are not a problem. The friendly management of Google Maps API V3 over other solutions, the easy interaction with GeoJson format and interactive/understandable examples were crucial to choose this solution.

3.3.1.1.2.2. Google Chart

Google Charts[31] is a tool that lets users easily create a chart from data and embed it in a web

[27] https://angularjs.org [accessed January 13th, 2015]
[28] https://developers.google.com/maps/documentation/javascript/ [accessed January 13th, 2015]
[29] https://developers.google.com/maps/documentation/javascript/tutorial [accessed January 13th, 2015]
[30] https://developers.google.com/maps/faq?hl=en#tos [accessed January 13th, 2015]
[31] https://developers.google.com/chart/ [accessed January 13th, 2015]

page. Charts are defined as JavaScript classes, creating a Portable Network Graphic (PNG)[32] image of a chart from all data provided in a proper format[33]. There are many types of charts customizable and highly interactive. There are alternatives to Google Charts, like D3[34], that provides several kinds of charts. As before, the reason to choose Google Charts is its simplicity in the use and the good related documentation.

3.3.1.1.3. Putting the pieces together

As this application is a new system, the design process starts in very early stages. First of all, it was a search about what is done in the field to plan all the functionalities and interactions while it is creating a relational concept map through mindmup[35] software. After the conception of all parts, it begins the design of the interface with moqups[36] software. Where all client pages are designed in order to have an idea of the functionalities required for the application, it starts CSS and JavaScript. This application uses several Client-side technologies, on one hand, part of JavaScript and CSS is performed by Bootstrap, on the other hand, JQuery is the JavaScript library necessary to empower the application and AJAX allows asynchronous methods. The application exchange format is JSON (see Section 3.3.1.3.2). Regarding maps and data visualizations, the application uses Google Maps API V3 and Google Charts, respectively.

3.3.1.2. Server side

Server-side scripting is a technique used in website design. This technique takes embedding scripts from HTML source returning responses to client-side after running on the server-side. There are different kinds of server technologies that can be used as Internet Information Services (IIS), Apache Web Server, Oracle/Sun Java System Web Server, IBM WebSphere Web Application Server, etc.

Java[37] is the programming language used in the backend part for this application. Java is a general purpose, high level, multi-platform, object oriented programming language. It is widespread and there are many resources, for example Oracle[38] offers several frameworks as Java Persistence API (JPA)[39] as well.

Two parts compose the server side: the database and the web server.

[32] http://en.wikipedia.org/wiki/Portable_Network_Graphics [accessed January 13th, 2015]
[33] https://developers.google.com/chart/interactive/docs/datatables_dataviews [accessed January 13th, 2015]
[34] http://d3js.org [accessed January 13th, 2015]
[35] https://www.mindmup.com [accessed January 13th, 2015]
[36] https://moqups.com [accessed January 13th, 2015]
[37] http://java.com/en/ [accessed January 13th, 2015]
[38] http://www.oracle.com/index.html [accessed January 13th, 2015]
[39] http://docs.oracle.com/javaee/6/tutorial/doc/bnbpz.html [accessed January 14th, 2015]

3.3.1.2.1. Database

A database is a set of data within the same context and systematically stored for later use. The data is typically organized to model reality in a way that it is possible to ask for information.

3.3.1.2.1.1. Postgresql

Postgresql[40] is an open source object-relational database management system (ORDBMS) published under BSD[41] license. As a database server, its primary function is to store and retrieve data. There are some open source alternatives, such as MySQL[42]. For the purposes of this application Postgresql is more useful, since it is able to process faster big amount of data than MySQL. Moreover, Postgresql offers an easy graphical interface to manage data: pgAdmin. This offers a very simple interface for data, able to query data and do spatial analysis through the spatial database extender POSTGIS.

3.3.1.2.1.2. PostGIS

As the application described in this dissertation needs more features than those provided by Postgresql, PostGIS has been used as well. PostGIS[43] is an open source spatial database extender for the PostgreSQL object-relational database. It adds support for geographic objects and allows to run spatial queries in Postgresql. Released under the GNU General Public License (GPLv2)[44], PostGIS adds several tools to manage geometry types such as points, linestrings, polygons, multipoints, multilinestrings, multipolygons and geometrycollections that enrich possibilities of Postgresql.

3.3.1.2.1.3. Java Persistence API (JPA) and hibernate spatial

"*Java Persistence API (JPA)*[39] *is a Java application programming interface specification that handles relational data in applications using the Java Platform Standard editions and Enterprise*"[45]. The aim of this API is not to lose the advantages of object orientation when interacting with a database. The reference implementation for JPA is EclipseLink[46]. Instead, in the application it is used Hibernate[47] in order to deal with PostGIS features with generic extension: Hibernate Spatial.[48] On the other hand, spatial queries must be implemented by native queries through JPA.

[40] http://www.postgresql.org [accessed January 13th, 2015]
[41] http://opensource.org/licenses/BSD-3-Clause [accessed January 14th, 2015]
[42] http://www.mysql.com [accessed January 14th, 2015]
[43] http://postgis.net [accessed January 13th, 2015]
[44] http://www.gnu.org/licenses/gpl-2.0.html [accessed January 14th, 2015]
[45] http://www.oracle.com/technetwork/java/javaee/tech/persistence-jsp-140049.html [accessed January 14th, 2015]
[46] http://eclipse.org/eclipselink/ [accessed January 14th, 2015]
[47] http://hibernate.org [accessed January 14th, 2015]
[48] http://www.hibernatespatial.org [accessed January 14th, 2015]

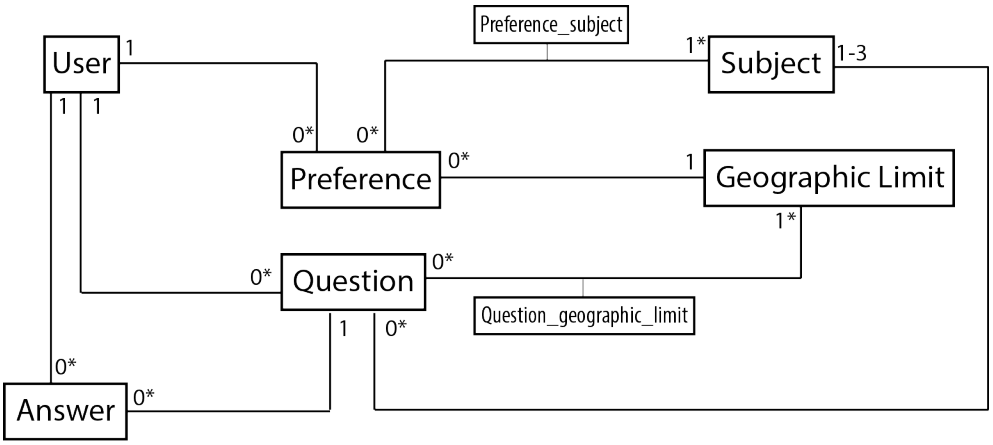

Fig 21.- Schema of the database

There are eight tables in the database (Fig 21); each one has different fields, according the application's demands. (see Appendix A: Database tables).

3.3.1.2.2. Web Server

"*A Web service is a software system designed to support interoperable machine-to-machine interaction over a network*"[49]. W3C also states that there are two major classes of Web services:

- REST-compilant Web services, in which the primary purpose of the service is to manipulate XML or JSON representations of Web resources using a uniform set of stateless operations
- Arbitrary Web services

Web services can run on a variety of platforms and frameworks. Web services are built on top of open standards such as TCP/IP, HTTP, Java, HTML, and XML or JSON.

3.3.1.2.2.1. Apache Tomcat

Apache Tomcat[50] is the server chosen to host the application's web server part. It can implement specifications to host Java web pages provided by the Apache License version 2. Moreover, Apache Tomcat is free, open source, very popular and light. The application uses Apache technologies (Apache Tomcat 7.0), attending the following characteristics:

- It is one of the most used server over the world
- It allows setting up files, like Common Gateway Interface (CGI) scripts (proxy host script).
- It manages object relational databases, needed for Web GIS.

[49] http://www.w3.org/TR/2004/NOTE-ws-gloss-20040211/#webservice [accessed January 12th, 2015]
[50] http://tomcat.apache.org [accessed January 13th, 2015]

3.3.1.2.2.2. Web service (REST)

Representational State Transfer (REST) is a technique of software architecture for distributed hypermedia systems like the World Wide Web. REST is used as a set of guidelines for creating web services. REST states that the Web has enjoyed scalability as a result of a number of key fundamental designs:

- Following a stateless protocol client/service
- It has a small group of well defined operations (POST, GET, PUT and DELETE)
- It has a universal syntax

3.3.1.2.2.3. Jersey

"*Jersey RESTful Web Services framework is an open source, production quality, framework for developing RESTful Web Services in Java that provides support for JAX-RS APIs and serves as a JAX-RS (JSR 311 & JSR 339) Reference Implementation.*"[51] It provides its own API adding tools to simplify RESTful services and client development. It is the reference implementation for REST services and Java.

3.3.1.2.3. Putting the pieces together

Simultaneously to client-side, it was developed the server part. Database was one of the first parts designed in the application, since it allows a global vision of the classes and relations within the system. As database server it was used Postgresql with spatial database extender POSTGIS. Then, JPA is used, with the generic extension Hibernate Spatial, providing a layer to access database data. The client and server side are communicated through web services using HTTP/Rest and server sends the response in JSON format. The server side software is implanted in Java and hosted by the open source web server Apache Tomcat.

3.3.1.3. Data exchange formats

In order to transfer information between systems, it is needed a transfer format to storage the data in legibly form and well structured. The two most used data exchange formats for WebGIS are EXtensible Markup Language (XML) and JavaScript Object Notation (JSON).

3.3.1.3.1. XML (EXtensible Markup Language)

XML is a markup language for encoding. It defines the elements in the information and its structure is similar to HTML. XML has a simple, well-defined structure and it is easy to understand by humans. This language defines a set of rules for encoding information in a way that is readable by a human and a computer.

[51] https://jersey.java.net [accessed January 15th, 2015]

Example[52]:

```
<employees>
    <employee>
        <firstName>John</firstName> <lastName>Doe</lastName>
    </employee>
    <employee>
        <firstName>Anna</firstName> <lastName>Smith</lastName>
    </employee>
    <employee>
        <firstName>Peter</firstName> <lastName>Jones</lastName>
    </employee>
</employees>
```

3.3.1.3.2. JSON (JavaScript Object Notation)

JSON interchange format is a way to store information in an organized, easy-to-access manner. JSON form is of type "attribute: value" and it is open standard. JSON is easily readable for humans as for machines to parse and generate, in comparison with XML.

Example[53]:

```
{"employees":[
    {"firstName":"John", "lastName":"Doe"},
    {"firstName":"Anna", "lastName":"Smith"},
    {"firstName":"Peter", "lastName":"Jones"}
]}
```

GeoJSON[54] is a variation of JSON for encoding Point, LineString, Polygon, MultiPoint, MultiPolygon and GeometryCollection geometries very useful in WebGIS applications.

3.4. Data

The application has two kinds of data: boundary data, related with the 54,655 available political boundaries in Spain; and user interaction data, resulting from user interaction with the system. The aim of this section is to briefly overview the process of obtaining and processing data.

3.4.1. Boundaries data

The Instituto Nacional de Estadística (INE)[55] is the official institution that manages statistics in Spain. In April 2014, INE released geographical data related to the census: digital cartography of the census outline corresponding to the delimitation of November 1st 2014 and excel files with some relevant demographic data. This milestone opened a new range of possibilities for applications using spatial component. The census is the minimum partition of a municipality and is also a basic limit for statistical studies in Spain.

Regarding the application exposed in this dissertation, this new resource was a very important landmark to think and develop the application since, as exposed in Section 2.1.2.1,

[52] http://www.w3schools.com/json/ [accessed January 12th, 2015]
[53] http://www.w3schools.com/json/ [accessed January 12th, 2015]
[54] http://geojson.org [accessed January 12th, 2015]
[55] http://www.ine.es [accessed January 15th, 2015]

place attachment is more likely and strong in sub municipalities environments.

"QGIS is a Geographic Information System (GIS) Open Source licensed under the GNU - General Public License". [56] (OSGeo) It was the responsible for creating from census section boundaries all the rest to achieve exactly areas and limits. QGIS offers a good communication with Postgresql[¡Error! Marcador no definido.] making migration easier to a Database.

Regarding the coordinate reference system (CRS), the official in Spain is the European Terrestrial Reference System 1989 (ETRS89). It is a geodesic-dimensional reference system, used as a standard for high-precision GPS georeferencing in Europe. By default, Google maps API use a CRS called Spherical Mercator with official European Petroleum Survey Group (EPSG) code 3857, while ETRS89, also used by INE, is 3042. In order to avoid projection problems, we have to set up all the spatial items with the same CRS. According difficulty that suppose change CRS in Google Maps, EPSG: 3857 - WGS84 Web Mercator (Auxiliary Sphere) is chosen.

3.4.2. User interaction data

In order to show some relevant visualization of the information gathered, some simulated data has been generated through Generatedata[57] software. It creates random data in different formats, although it cannot generate geometries like points, lines, etc. However, QGIS allows the creation of random points inside polygon. Combining both, it is possible to use a representative amount of users, and their preferences, to test the application.

3.5. Actors and interactions between them

This section aims to define the whole application in order to have a broad perspective about the potential achievements in the social field and how spatial component can become a very powerful tool for creating a breaking application in this field.

To accomplish this goal, the application is designed around two basics components: spatial and user interests. In order to set up a really innovative application, besides spatial component, it is also added preference component to avoid spam and receive only questions, petitions and participative processes according to user's interests.

3.5.1. User stories

The application described in this dissertation has several ways to interact with it. The following list wants to expose some examples, user stories[58], covered by the application.

[56] http://www.qgis.org/es/site/ [accessed January 15th, 2015]
[57] http://www.generatedata.com [accessed January 15th, 2015]
[58] http://www.agilemodeling.com/artifacts/userStory.htm [accessed January 16th, 2015]

This list provides a scope of the application; it is important to bear it in mind in order to design and set up the application.

- As a district/municipality/province/autonomous/country government I would like to have the possibility to make a query to citizenship in order to know their opinion about a subject.
- As a district/municipality/province/autonomous/country leisure section I would like to have the possibility to query to citizenship in order to choose the band playing in the next local festival.
- As a district/municipality/province/autonomous/country government I would like to have the possibility to do a Public Participatory process through Geographical Information Systems (PPGIS), receiving opinion from citizenship about planned issues.
- As citizen I would like to have the possibility to create a petition to try to change something. To achieve the maximum possible support, when sharing it on social networks, I want to make sure that it goes to the people who live close to the problem.
- As an inhabitant of a neighbourhood I would like to have the possibility to ask the neighbours about a subject to know the opinion of the people around me.
- As a citizen or collective I would like to have the possibility to create groups of people and channels (see Section 3.5.4) to stay connected with people who has similar interests, in a certain area.
- As a student I would like to have the possibility to poll people within a certain area for my dissertation project.

Nowadays, some of this user stories are not treated by any application. Thus, the application born with the aim to fulfil these lacks related with spatial component.

3.5.2. Main actors of the application

3.5.2.1. Inhabitant

Inhabitant is one of the two kinds of user. In order to define the inhabitant, the system asks to fulfil some fields in the registration process. These characteristics are name, address, age, mail, gender, privacy status (anonymous or public) and password. Features can be modified afterwards from the application

3.5.2.2. Collectives

Collective is the other kind user. It is a group of inhabitants sharing least one administrator

and one common interest. To register a collective in the system, the administrator has to fulfil a form with his/her personal, but with some additional such as phone number, webpage, collective nature and subgroups design. As defined in literature review, it is important to distinct between a group of citizens (channel) and a group of citizens with a shared interest (collective or association), many times behind this last there is a legal form. Collective parts are defined as follows:

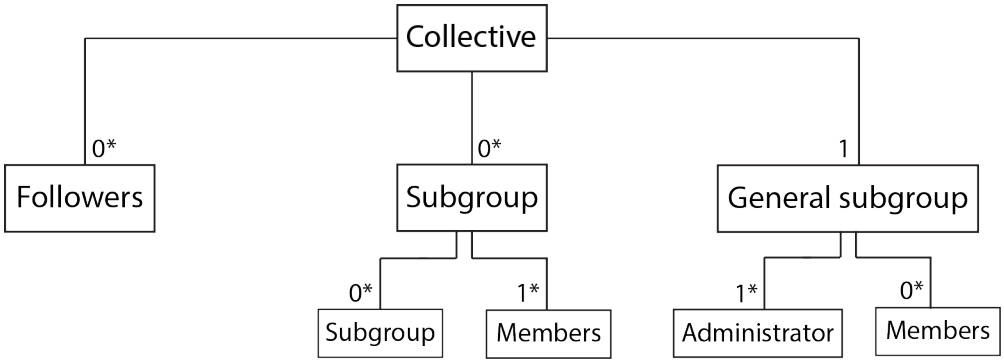

Fig 22.- Schema of the parts of a collective

Fig 22 shows the relation between parts of collectives. It is important to distinguish between the followers and the members of a collective. While followers are citizens that receive questions and petitions from collectives whenever they want to share them, members are citizens with rights to create actions in behalf of the collective. A member can be an administrator.

Subgroups are part of the collective and there are two kinds: general and others. In the former only the subgroup with administrator who decides to which subgroup each action goes. The latter are subgroups composed by members with the characteristic that can contain other subgroups. These subgroups only can receive intern questions and petitions filtered by the administrator.

3.5.3. General functionalities and definitions

The aim of this section is to expose all the components necessary to understand the application's flow. As exposed above, the application has two kinds of users: inhabitants and collectives**.** Each kind of application's user has enable same functionalities, collectives has some extra functionalities.

3.5.3.1. Registration and preferences

To recognise an inhabitant or collective as a user, there is a process of registration within the application.

Inhabitant. Registration procedure consists of two parts. On one hand users can enter to the

application by connecting to their Facebook or Google+[59] account or by creating a new user. Whatever the case, it is mandatory for users to define exactly where they live. Through a map, users can locate their home or type their address. An information panel explain users that their opinion will never be disclosed as a point on the map, for results are sorted by areas. It is an important step, since the application is largely based on user location in order to obtain relevant spatial data. On the other hand, there is a process to define preferences where users define the geographical limits and interests (subjects) related with the questions, petitions and participatory processes they receive.

- Questions. Users can define what kind of questions (subjects) they receive, from their own census section, district, municipality, province and autonomous community. Moreover, the system wants to take into account people with different interests to their own areas. In order to cover this variant, the application has a **geographic tag**[60].
- Petition. Petitions are similar to questions but without the limitation of having to choose own areas in order to receive petitions and support them. Therefore tags are not necessary in petitions.
- Participatory process. Users can define what kind of participatory processes (subjects) they receive, from their own census section, district, municipality, province and autonomous community. Moreover, it can be the possibility that certain collective does not care from wherever people can participate, for this case also it is available the geographic tag.

Collectives. Registration process to collectives is different because it is important to guarantee their identities. First of all, to enter the application, a collective has to fill an online form provided by the system. This form asks for an administrator in order to have a responsible of the collective. Feedback from the system goes in both directions, to the administrator and collective. Until the administrator is not registered in the system as an inhabitant the community can not be registered. Preferences procedure is exactly the same as for inhabitants. One collective can have several subgroups. For instance, a medium-big enterprise has different departments: labour relations, accounting, etc. each of these apartments can be a subgroup. On the other hand, another example of subgroups can be Guanyem's commission: participation, communication, etc. The application wants to provide the possibility to manage relationships between collective and subgroups in terms of questions, petitions and participatory processes. At least, each collective has to have one general subgroup.

[59] https://plus.google.com [accessed January 16th, 2015]
[60] **Geographic tag** is defined in questions and participatory process. The aim of this feature is to allow users receive actions from different to their areas, as long as it defined by initiators users.

3.5.3.2. Make a Question

This application's functionality is comparable to SoftGIS methodology. They have the same aims; generating soft data reusable by users with different objectives. The application described in this document, to some extent, share SofGIS' goals, seeking the way to introduce subjective data in general policy and day life affairs.

An important part of the application is the question system. This functionality wants to provide users of the application with the option to send a query to any administrative boundary or selected area in the country, any collective or channel of the system or their followers.

3.5.3.2.1. Open question

Open questions have free answers. This means that there is a process running to obtain the most famous answer from all. Appgree uses a breaking algorithm[61] to carry on this process. The idea is to develop a similar own algorithm to manage with this issue.

Inhabitant. To make a question an inhabitant has to fill some information, such as:

- Kind of question: text question or date question.
- Available time for the question
- Define the question
- Subject**:** in order to send the most possible relevant questions to the user, the questioner has to select at least one subject related with the question (with maximum of three).
- Field to send the question**:** There are several enable options to send the question, each one of the following list can be mixed to achieve more flexibility:
    - Geographic limit: chosen using a map (see Fig 24)
    - Direct questions: to collectives and followers
    - Send to mail contacts
    - Geographic Tag
    - Send to channel which is part
    - Send to new geographic limit defined by user.
- Visibility (public or private): any user can see results (public) or results can only be seen by the questioner and the survey respondent (private).
- Global diffusion. Any user can answer and see results.

Collectives. The relation between collectives and questions has the same behaviour as inhabitant and question, although this one it has to take into account that direct question have

[61] http://www.appgree.com/how-it-works/

a new feature: the possibility to send intern questions to subgroups of the collective or members.

3.5.3.2.1.1. Geographic Question

Inhabitant and collectives. Geographic questions (geoquestion) have the same features of a normal open question but its answers are done through a map. So, the features are the same exposed above but answers are selected through the map in the form of geometry elements such as points, lines and areas. Furthermore, users can add some comments related with their answers.

3.5.3.2.2. Close question

Questioner defines the answers available for the questions. There are four kinds of questions accessible: yes or no, test, scale of valour and multiple choice**.**

Inhabitant and collectives. Close questions have the same structure of open questions. However, geoquestions are not available for this kind of question, being a geographic form instead.

3.5.3.2.2.1. Geographic Form

Inhabitant and collectives. Geographic form (geoform) is the only way to make more than one question at the same time. Instead of displaying a list of questions, geoform creates a virtual travel through the map, stopping in certain places where questioner defined close questions. Geographic form has the same features of a normal close question but with two differences: they can have more than one question and possible answers are displayed in a map. Thus, the features are the same exposed above but the answers are selected through the map, although each question as treated as independent. Furthermore, users can add some comments related with their answers.

3.5.3.3. Do a Petition

Inhabitant and collectives. Another important part of the application is the petition system. This functionality wants to provide to any user of the application the option to send a petition to any boundary of the country, any collective or channel of the system or their followers. The general structure is identical to question one, concretely field to send petition and define the petition. There are some variations typical of petition procedure:

- Add addressee: to whom the petition is directed
- Brief description of the reasons
- Visibility only can be public
- Publish: these features are inherent for petition processes: promote, update, etc.

3.5.3.4. Answer a Question or Sign a Petition

Inhabitants. There are four ways of receiving a question or petition for an inhabitant: from another inhabitant, collective, channel or following user. When users send a question or petition, it appears as a notification, since it may not be related with the topics of interest of the inhabitant, who is given the possibility to refuse to answer. Besides to answer the question, there are several features available as sharing, commenting, denouncing, etc.

Collectives. In the case of collectives, it is not as simple as with inhabitants. All the questions and petitions sent to the collective are saved as notifications. The administrator of the group is in charge to accept the question or petition and decide which scope has inside the collective. In other words, the administrator decides to which group the question or petition should be shared. On the other hand, administrator can block a user in order to stop receiving more actions from him or her.

3.5.3.5. Do a PPGIS or PGIS process

As it was stated in Section 2.1.3.4.1 there are some PPGIS and PGIS processes already available and they will increase in coming years. This functionality wants to normalize this kind of processes, bringing easy tools closer to collectives and enabling them to create participatory processes through a map without needing to be an expert on the subject. Furthermore, the advantage of having all processes in one application can help to share good practises among users.

Collectives. Each collective can initiate a PPGIS or PGIS process. The application defined in these pages can cover several entities of the society, giving the opportunity to make participative process through a map. Then, collectives have an extra section compared with inhabitant where engage participation. Features of this functionality are like Section 3.5.3.2 but the interface is composed by a map where collective can add relevant spatial data such as layer of municipality's planning, opening a participatory process, for instance. The residents' experiential knowledge is mapped and presented on an open platform together with formal knowledge produced by the authorities. The bottom-up approach includes an easy-to-use interface and constant cooperation with local users.

3.5.3.6. Visualize results

Users only can see results of questions or petitions made or answered (unless questioner define question as public) by them. There are two ways of visualizing the data.

3.5.3.6.1. Bubble chart

Inhabitant and collectives. The aim of this visualization is crossing different questions to

obtain useful interactions and, if possible, to notice some correlation between them. Before selecting a question or petition, users can filter items to be displayed by topic, user, geographic limit, time or text. In close questions, it appears a selector with possible answers to choose from. Once chosen the first one, the application makes a spatial matching to select all possible secondary questions or petitions with exactly the same geographic limit to make the visualization possible. Finally, when both are selected it is time to choose geographic limit to performance the chart. Within the chart, there are several combinations to show related with the answer's options. The users can select each answer per each question, according to their needs, obtaining different representations of the data.

3.5.3.6.2. Map

Inhabitant and collectives. The structure is similar to bubble chart, but in this case it is only possible to visualize one question or petition at once. The rest of the steps are the same (except matching) to obtain a map where visualize answers or supports by geographic limit.

3.5.3.7. Download results

Inhabitant and collectives. There are several ways to download results. One of the application's aims is to be a source of social data about opinion. From this point of view it is important that each user can download questions or petitions made or answered. The results can be downloaded, sorted a by geographic limit, never as points not to reveal the exact opinion of users. As described in the visualization process, users can filter questions by different elements and select the geographic limit. It is also possible to download data and share or print graphs of the visualizations.

3.5.4. Other functionalities

These functionalities are separated in three groups, one common to inhabitants and collectives and the other two related for each one.

Common functionalities:

- Follow/unfollow: users can follow and unfollow any inhabitant, collective or public channel. When a user is following another, he/she will receive all the actions done by the followed user, unless the latter limits the geographic scope of the question or petition.

- Create a channel: there is the possibility to create a public or private channel. It is also possible to invite users to the channel. Public channels have free entrance for any user of the system, while private ones, require users to send requests to be

admitted, managed by the Administrator.

- Search: There is the possibility to search by user or question within the application.
- Gamification: both each question answered and each petition signed count. The application rates each user in terms of participation. In each profile different punctuations are visible, regarding the number of questions or petitions made, number of followers, etc. What it is really interesting of this functionality is to be able to sort scores by geographic limits and create a kind of challenge between municipalities. For instance, about which one is more participative in order to encourage contribution in the application and avoid poor rates of participation in processes of this kind.

Inhabitants:

- Be a member: inhabitants can be members of a collective. To be a member of a collective the approval of the administrator is required. Being a member of a collective, inhabitant can make questions on behalf of the collective.

- Profile: each inhabitant has a profile in order to download signatures of a petition or change final date to question or petition. Also it is possible modify some settings of the profile such as address, privacy, etc.

Collectives:

- Be a member: collective can be members of another collective. To be a member of a collective the approval of the administrator is required. Being member of a collective is like following it. The idea behind member functionalities in collectives is to cover all associations and enterprises that have dependence each other. For instance, the hiker centre of a municipality surely depends on a higher province organism.

- Profile: each collective has a profile in order to download signatures of a petition or change final date to question or petition. Also, it is possible to modify some settings of the profile such as address, privacy, change or create an administrator, create a subgroup and delete a member, etc.

3.6. Implemented functionalities

Due to the large size of the application and the limited time to prepare the dissertation, the implementation part focuses on the functionality of close questions (yes or no, test and scale

of values) between inhabitants. Regarding the topic of the question, geographic limits and tags are available as well as bubble chart visualization and download feature. In fact, in terms of technology used, the implemented application represents most of the whole application, remaining part only adds specific variations for each functionality.

3.6.1. Creating a close question

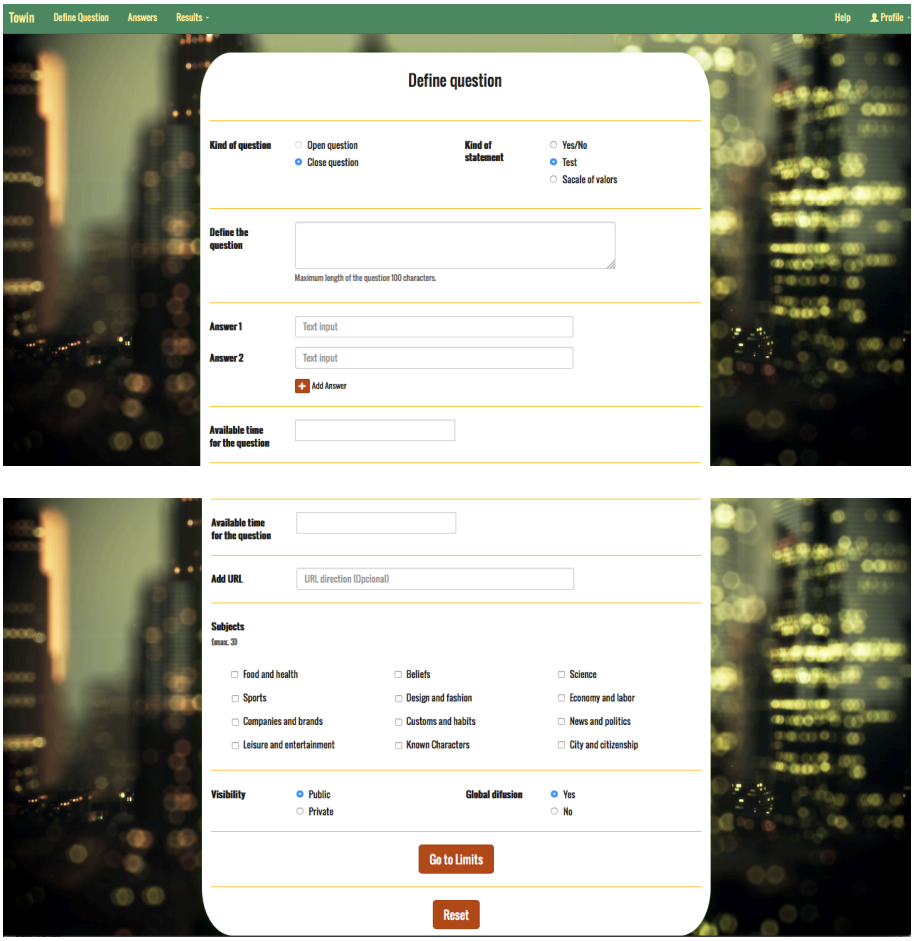

Fig 23.- Web user interface for a definite question

Fig 23 shows the interface of a page to define the question. The *creating a close question* page is divided in several sections of the form, in order to characterize the question. For making the process simpler, sectors appear in a logical way depending on the previous choice. Once all the mandatory fields are fulfilled, the user can press the "*Go to limits*" button.

3.6.2. Defining limits

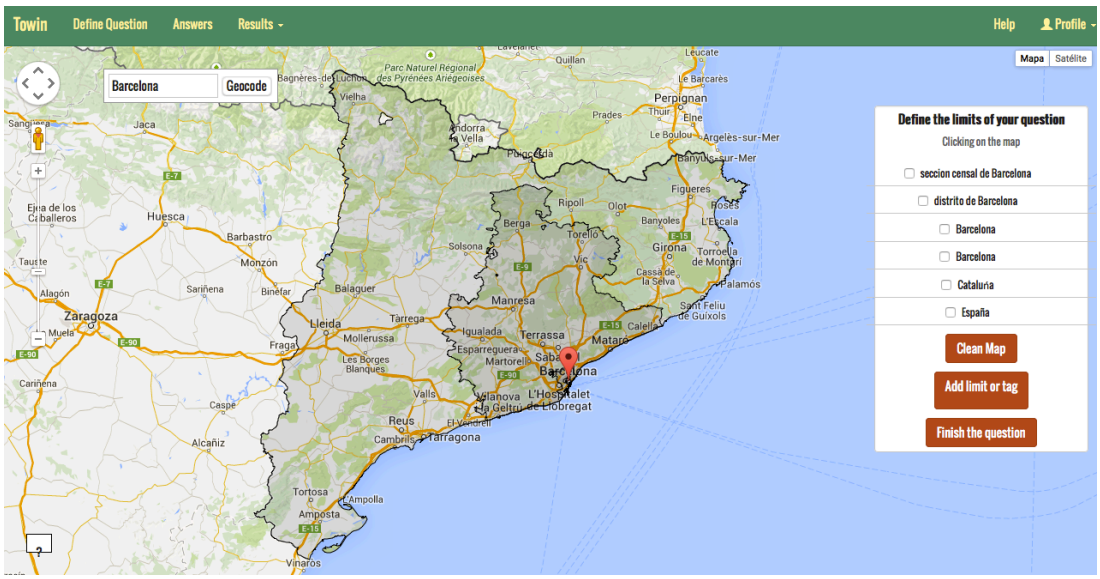

Fig 24.- Web user interface for defining limits

Fig 24 presents webpage responsible to choose the limits where to send the question. As described in Section 3.1.1, Spain has five official political and administrative boundaries. The aim of this webpage is to provide the user an easy tool to send any question, inside Spanish territory, just by clicking on the map. After this, the geometries of the five official boundaries related with clicking point appear on the map. Simultaneously, on the right side there is a panel for choosing the available areas. When the user chooses an area, there is the option of selecting geographical tags, related with the current area as well. There is no limit to the number of areas or tags for a question. Once all the boundaries are selected, the user must click the "*Finish the question*" button in order for the system to make the matching and send the question to the relevant users.

3.6.3. Answering questions

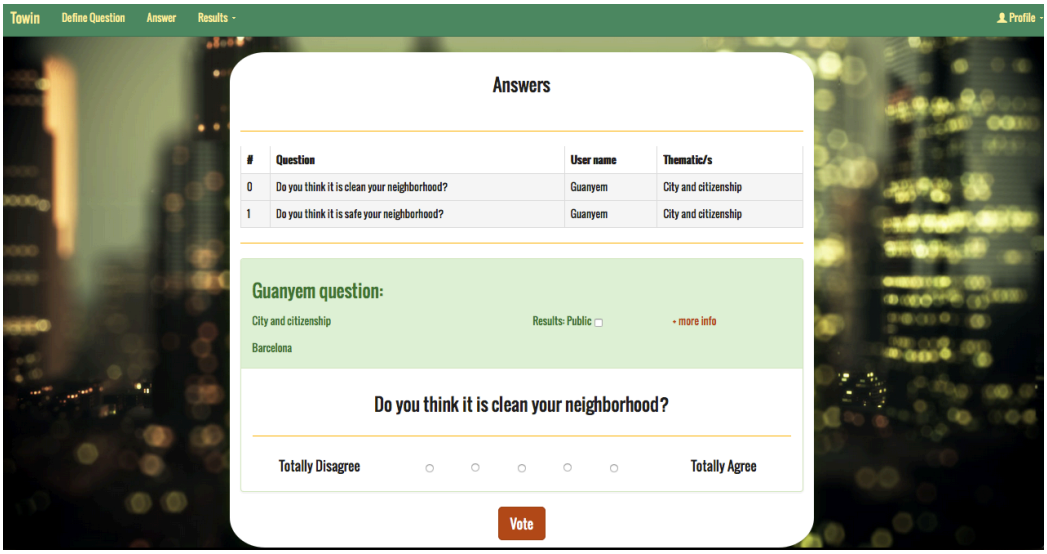

Fig 25.- Web user interface for answering questions

Fig 25 presents an answer question interface. In this webpage, all the questions suitable for certain user appear. As explained before, this suitability are composed by two components: spatial and interests. If a question sent by a user pass these two filters, this question appears in the answer webpage to be answered. In the top table it appears the user name and header of all questions accessible and by clicking one the entire question is displayed below, with all the information available: user name, subject related, limit where it was sent, visibility of the results and a link for more information.

3.6.4. Show results. Bubble chart.

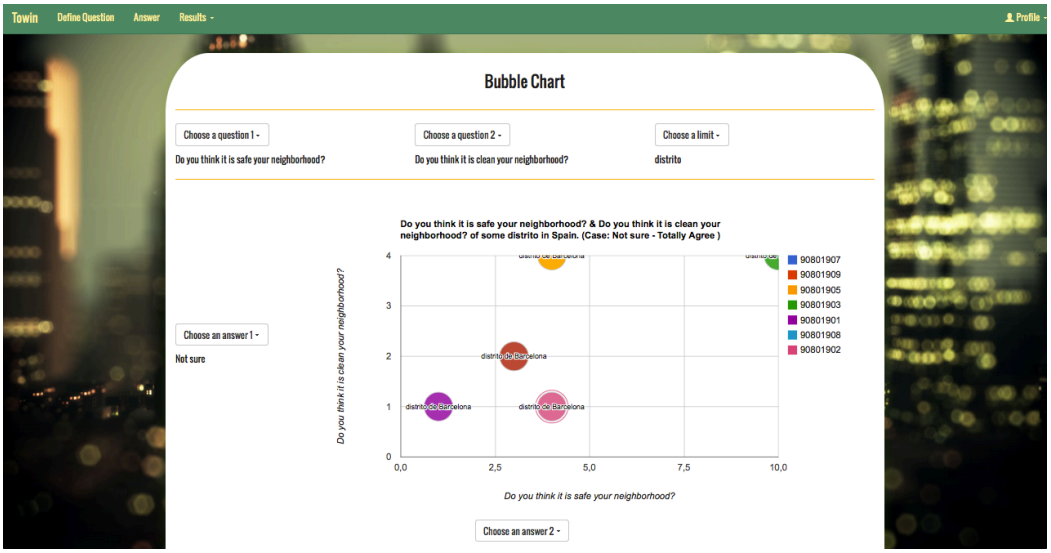

Fig 26.- Web user interface for visualizing data

Fig 26 shows the results in a webpage: bubble chart. The process to select both questions is described in Section 3.5.3.6.1. The reason to choose bubble chart over another type of visualization is the possibility of crossing questions and giving users the possibility to exchange questions and create new interactions as they please.

Two parts compose this webpage: a bubble chart and a map to localize the different figures' geometry of the chart. Since districts and the census do not have a name associated to them and they have an identification number, it is mandatory that a figure recognizes the meaning of each bubble in the chart. For the application, it is very important to choose the appropriate chart, attending to its nature and to whom all the information is addressed, in order to show the right amount of understandable information.

3.6.5. Download results

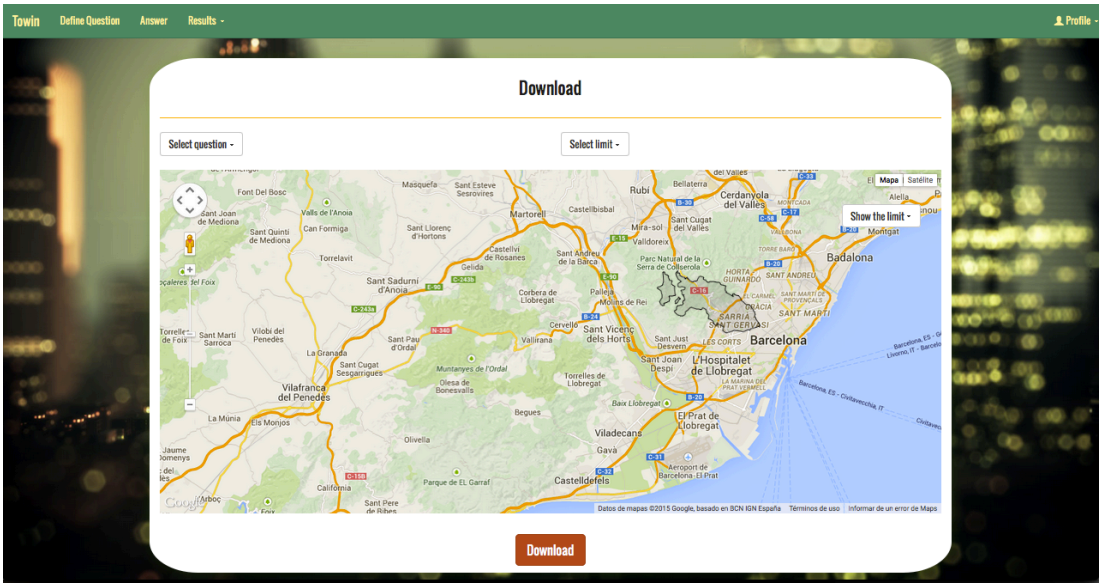

Fig 27.- Web user interface for downloading data

Fig 27 shows the web page to select question available to download per each user. It is possible also filtering by limit. As in bubble chart webpage there is a map to help users to locate where are the areas downloaded, making possible recognise districts and census sections.

This page is one of the options when downloading results, and each visualization available in the application has the possibility to download the results showed in the screen as well as the visualization image. Data related with questions and petitions are enabling for downloading by Comma-separated Values (CSV)[62].

[62] http://en.wikipedia.org/wiki/Comma-separated_values [accessed January 14th, 2015]

4. Discussion

The new approach of dissertation's application appeared after comparing similar applications. There are some similarities between the application described in this work and exposed applications in *Similar Applications* section. For example, change.org process to support initiatives, social network (QueryDay), channel idea (Appgree) and public and private groups (Yopp). The main difference with them is the treatment of spatial component. According to the comparisons (Table 2 and Table 3), none of them seem to take this feature into real consideration, not taking advantage to an important component attending *Study Cases* section. This application fulfils this lack of spatial component and also looks after the interests of the users in order to send them actions on which they are really interested based on the spatial component.

Some limitations and difficulties appeared during the elaboration of this work. On one hand, WebGIS technologies are different from other desktop-based developments. They need a server to test the code and a geographic component, as it is crucial for both web services scripting and databases. The connection between web services and database (JPA) was more intricate when dealing with spatial component, even more when documentation is insufficient. On the other hand, to create an application from the scratch is an arduous process. Besides connection process between client and server part, testing and manipulating big amount of data, selecting the suitable technology for each part, etc. It is a hard job to devise all the associations between users and functionalities, that is to say, to design a whole application. During the writing of Literature Review, it was found new concepts such as SoftGIS. SoftGIS methodology, which was implemented in Scandinavian area in recent years, has a long way to go in production of location-based data from residents. Most of this approaches are about urban planning [1], [53]. Nevertheless, this application is a tool for the entire society, empowering both citizens and collectives, and it is ready to engage in any kind of participatory process through a map. Furthermore, the described application joins the spatial component with users interests to be more flexible and suitable for users, allowing both to filter all the received actions (questions, petitions and participatory processes) and to visualize and download the resulting data.

5. Conclusions

This dissertation has a new approach to current social applications for questions, petition actions and participatory processes. In response to the research question posed in this dissertation, this work makes clear how spatial component is treated as a main feature of the system to develop all others depending on it. From this perspective, brand new interactions and features appear, that improve the possibilities of communication between the actors of society, that empower citizenship, by providing a new social tool based on spatial component related to their interests, and that offer to the entire society new subjective geolocated data ready to use. Governments and institutions have a lot of quantitative data but tend to forget qualitative data (soft), the opinion of people, their interests, etc. This application helps society by being a channel through which the aforementioned data can be geolocated, gathered and downloaded while empowering the society. Moreover, it offers an opportunity to create a network between society's actors (see Fig 22), a network where collectives are connected and prepared to share knowledge.

Based on spatial component, the implemented application allows users to send questions or petitions to any administrative boundary in Spain, getting suitable data for downloading and meaningful visualizations. In order to achieve this milestone, from the technical point of view, the application is the result of a combination of technologies. The implementation shows that it is possible to get a working application mainly using open source, with the possibility of filtering, visualizing and processing questions and petitions. In the building process, the latest technologies were used to implement the system, having a thin client and the most suitable web services technologies possible. The resulting application provides a new scope to local scale, since it enables people to act locally, apart from globally. Neighbourhood, surroundings are available areas to be selected giving new capabilities to the system and lots of possibilities.

This application can be used in several ways, as stated before. Due to the transversality of the application there is a number of resources associated with a big potential of becoming a huge supplier of data. The whole application is designed to be useful for society creating a network between society's parts in one system, helping to share good practises and transparent initiatives. The application's flexibility and its open approach provide the same importance to all kind of users.

The present work goes through the complete process of designing an application: from the architecture and design description to part of its implementation. It proposes, on one hand, a new way to deal with questions and petitions from a spatial component related to user interests, moreover it purposes a widespread and easy way to deal with PPGIS, PGIS and

SoftGIS methodologies from the same application. This hybridization makes sense attending to the relation that can be among them. However, regarding SoftGIS, as J. Corburn point to in his paper [53], it seems that policy processes are not organized to include this subjective knowledge. This application can help merge easily both "hard" and "soft" data.

There are many improvements plan to be developed (see next Section), but this work has helped emphasise spatial component in question and support based applications, identifying the importance of this feature in this kind of applications. This software system opens a new general approach to engage collectives in creating participatory processes and, to all users, in the possibility to send a question or petition to any administrative division in the country as well as to visualize and download resulting data. The application described in this dissertation can become crucial to achieve transparent governments, strong social collectives and citizenship empowerment.

5.1. Future work

The described system covers just some functionalities that can be upgraded and improved in order to become a reference application in the field. New ideas are introduced for further developments and improvements on the work done so far. The general idea of the extensions is to become an application where all suitable social initiatives and actions can be gathered, obtaining a comprehensive application based on the spatial and users preference component.

1. To improve the implemented application in order to add petition functionalities to inhabitants and collective functionalities described in Section 3.5.3.3 and 3.5.3.5.

2. Crowdfunding. Regarding place attachment (see Section 2.1.2.1) it seems a good idea for this application to cover crowdfunding processes as well. It is clear that the wider the initiative's scope, the more monetary support the user can receive. For example, platforms such as Verkami[63] and Goteo[64] use the same methodology as change.org to spread the actions through social networks. As discussed before, the application's approach does not want to replace any channel of spread but to add a spatial one.

3. Being able to send messages between users or to certain area is basic to be a whole spatial social-based application. Nowadays, Whatsapp[65], Twitter[66] and Facebook are

[63] http://www.verkami.com [accessed January 25th, 2015]
[64] https://goteo.org [accessed January 25th, 2015]
[65] https://www.whatsapp.com/?l=en [accessed January 25th, 2015]
[66] https://twitter.com/download?logged_out=1&lang=en [accessed January 25th, 2015]

the leading applications on social relations through Internet. The application described in this dissertation knows about these leading roles but also points some of their lacks related to the spatial component. For example, Facebook does not allow to users notify directly something to a certain area and users only can spread their message through nodes (profiles) or groups. Thus, this application adds a value to Facebook. Implementation of this functionality can be made through Twitter, giving each area a hash tag.

4. Mobile application. The application design is responsive, but the next natural step is to create a mobile application. Within this stage, there is an important point to take into account: location-based questions or petitions by mobile devices that are not related to the users' address but to their current position. This approximation can make possible to add participatory sensing processes through crowdsourcing data by mobile. [65] Furthermore, using a mobile app the interaction with existing social networks (Twitter, Flickr[67], etc.) makes more sense, since it allows real time interaction. The two following points are VGI approaches using sensing mobile technologies.
    a. Twitter. Through hash tags, users can share information on Twitter, related to their area. Each area must have a unique hash tag. Twitter can be the tool through which users can add social events and send notifications to a certain area. Thanks to spatial component, hash tags can be related to the city council area, in such a way that, for instance, damages on the street can be reported to the pertinent town hall by using them.
    b. Flickr. It also can deal with photos and connect occurrences with its relevant city hall.

5. Implement OGC[68] Web Services. In order to provide useful information to PPGIS and PGIS processes, it can be interesting to consider adding web services to maps visor such as Web Map Service (WMS)[69] or Web Feature Service (WFS)[70].

6. Connecting with official data. It will be interesting to add official data (hard) from administrative boundaries to allow users to cross different kind of data: quantitative and qualitative.

[67] https://accounts-flickr.yahoo.com [accessed January 25th, 2015]
[68] http://www.opengeospatial.org [accessed January 25th, 2015]
[69] http://en.wikipedia.org/wiki/Web_Map_Service [accessed January 25th, 2015]
[70] http://en.wikipedia.org/wiki/Web_Feature_Service [accessed January 25th, 2015]

7. To allow users to create new subjects. To achieve a personal and flexible application, future work must allow users to incorporate new subjects to make the application more precise.

8. Thematic maps. While users are answering questions, supporting petitions or taking part in participatory processes, the stored records can be treated like thematic maps or layers with subjective data. They can be crossed with hard data within the application to obtain custom maps. For example, dumpsters' position (hard data) can be intersected with street's filth perception (soft data). Furthermore, the idea to share these subjective data with open source software such as Open Street Maps (OSM) can be studied. On the other hand, it can be considered the upload of external spatial data to the application to provide them analysis and interactive visualization.

9. Participation rates. Future works also go in how to manage low rates of participation in this kind of process and how to make society see that participating in these kind of processes have an impact on transparency and citizen empowerment.

6. Bibliographic References

[1] K. SCHMIDT-THOME, S. WALLIN, T. LAATIKAINEN, J. KANGASOJA, AND M. KYTTÄ, "Exploring the use of PPGIS in self-organizing urban development: Case softGIS in Pacific Beach," *J. Community Informatics*, vol. 10, no. 3, 2014.

[2] M. KYTTÄ, A. BROBERG, T. TZOULAS, AND K. SNABB, "Towards contextually sensitive urban densification: Location-based softGIS knowledge revealing perceived residential environmental quality," *Landsc. Urban Plan.*, vol. 113, pp. 30–46, May 2013.

[3] G. BROWN AND M. KYTTÄ, "Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research," *Appl. Geogr.*, vol. 46, pp. 122–136, Jan. 2014.

[4] A. CORNWALL AND J. GAVENTA, "From Users and Choosers to Makers and Shapers Repositioning Participation in Social Policy 1," *IDS Bull.*, vol. 31, no. 4, pp. 50–62, Oct. 2000.

[5] C. PRESS, "The Scope of Social Technology Author (s): C . R . Henderson," vol. 6, no. 4, pp. 465–486, 2015.

[6] T. DELARBRE, "Internet como expresión y extensión del espacio público," *Rev. MATRIZes*, vol. 2, no. 2, pp. 1–16, 2009.

[7] V. CAROLINA, "¿Qué es la web 3.0? … o qué dicen que es…," 2011. [Online]. Available: http://wwwhatsnew.com/2011/04/04/¿que-es-la-web-3-0-o-que-dicen-que-es/. [Accessed: 03-Jan-2015].

[8] D. DI SIENA, "Web 3.0 y la trasformación del espacio (físico) | ecosistema urbano," 2010. [Online]. Available: http://ecosistemaurbano.org/castellano/web-3-0-y-la-trasformacion-del-espacio-fisico/. [Accessed: 03-Jan-2015].

[9] T. O. REILLY AND O. R. MEDIA, "What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software," *Commun. Strateg.*, vol. 65, pp. 17–37, 2007.

[10] B. B. ALEXANDER, "Web 2.0: A New Wave of Innovation for Teaching and Learning?," *Educ. Rev.*, pp. 33–44, 2006.

[11] A. HUDSON-SMITH AND A. CROOKS, "The renaissance of geographic information: neogeography, gaming and second life," 2008.

[12] C. L. COYLE AND H. VAUGHN, "Social networking: Communication revolution or evolution?,"

Bell Labs Tech. J., vol. 13, no. 2, pp. 13–17, Aug. 2008.

[13] D. REIG, *Socionomía*. 2012.

[14] B. A. H. MASLOW AND C. D. GREEN, "A Theory of Human Motivation," *Psychol. Rev.*, vol. 50, pp. 370–396, 1943.

[15] S. GALLIANO AND G. LOEFFLER, "Place assessment: How people define ecosystems," 1999.

[16] L. C. MANZO, "Beyond house and haven: toward a revisioning of emotional relationships with places," *J. Environ. Psychol.*, vol. 23, no. 1, pp. 47–61, Mar. 2003.

[17] F. STEELE, *The sense of place*, vol. 87. 1981, p. 216.

[18] I. ALTMAN AND S. LOW, "Place Attachment," in *Human behavior and environments: advances in theory and research.*, New York, USA, 1992.

[19] D. STOKOLS AND S. A. SHUMAKER, "The Psychological Context of Residential Mobility and Weil-Being," *J. Soc. Issues*, vol. 38, no. 3, pp. 149–171, Oct. 1982.

[20] H. M. PROSHANSKY, "The City and Self-Identity," *Environ. Behav.*, vol. 10, no. 2, pp. 147–169, Jun. 1978.

[21] G. S. MESCH AND O. MANOR, "Social Ties, Environmental Perception, And Local Attachment," *Environ. Behav.*, vol. 30, no. 4, pp. 504–519, Jul. 1998.

[22] G. G. BROWN, P. REED, AND C. C. HARRIS, "Testing a place-based theory for environmental evaluation: an Alaska case study," *Appl. Geogr.*, vol. 22, no. 1, pp. 49–76, Jan. 2002.

[23] S. TARTAGLIA, "Different predictors of quality of life in urban environment," *Soc. Indic. Res.*, vol. 113, no. 3, pp. 1045–1053, 2013.

[24] C. M. RAYMOND, G. BROWN, AND D. WEBER, "The measurement of place attachment: Personal, community, and environmental connections," *J. Environ. Psychol.*, vol. 30, no. 4, pp. 422–434, Dec. 2010.

[25] M. LEWICKA, "What makes neighborhood different from home and city? Effects of place scale on place attachment," *J. Environ. Psychol.*, vol. 30, no. 1, pp. 35–51, Mar. 2010.

[26] B. HERNÁNDEZ, M. CARMEN HIDALGO, M. E. SALAZAR-LAPLACE, AND S. HESS, "Place attachment and place identity in natives and non-natives," *J. Environ. Psychol.*, vol. 27, no. 4, pp. 310–319, Dec. 2007.

[27] J. KASARDA AND M. JANOWITZ, "Community attachment in mass society," *Am. Sociol. Rev.*,

vol. 39, no. 3, pp. 328–329, 1974.

[28] J. GUSFIELD, *Community: A critical response*. 1975, p. 120.

[29] D. R. WILLIAMS AND J. J. VASKE, "The Measurement of Place Attachment: Validity and Generalizability of a Psychometric Approach." 2003.

[30] G. KYLE, "Testing the Dimensionality of Place Attachment in Recreational Settings," *Environ. Behav.*, vol. 37, no. 2, pp. 153–177, Mar. 2005.

[31] P. BOURDIEU, *Distinction: A Social Critique of the Judgement of Taste*. 1984, p. 613.

[32] M. FOUCAULT, J. VARELA, AND F. ALVAREZ-URÍA RICO, *Microfísica del poder*. 1978.

[33] B. JORDI, "CIUDADANÍA Y ESPACIO PÚBLICO," 1998. [Online]. Available: http://urban.cccb.org/urbanLibrary/htmlDbDocs/A011-B.html. [Accessed: 05-Jan-2015].

[34] F. TÖNNIES, *Studien zu Gemeinschaft und Gesellschaft*. Wiesbaden: VS Verlag für Sozialwissenschaften, 2012.

[35] M. ARCAS, "Ferdinand Tönnies: El Conflicto entre comunidad y sociedad," *Ethn. Rev. Antropol.*, vol. 10, pp. 85–89, 1975.

[36] É. DURKHEIM, *Las reglas del método sociológico*. 1997.

[37] M. HALBWACHS, *On Collective Memory*. University of Chicago Press, 1992, p. 244.

[38] M. SCHLOSSBERG AND E. SHUFORD, "Delineating ' Public ' and ' Participation ' in PPGIS," pp. 15–26, 2005.

[39] S. R. ARNSTEIN, "A Ladder Of Citizen Participation," *J. Am. Inst. Plann.*, vol. 35, no. 4, pp. 216–224, Jul. 1969.

[40] A. DORCEY, L. DONEY, AND H. RUEGGEBERG, "Public Involvement in Government Decision-Making: Choosing the Right Model.(Victoria, Round Table on the Environment and the Economy)," 1994.

[41] P. WIEDEMANN AND S. FEMERS, "Public participation in waste management decision making: analysis and management of conflicts," *J. Hazard. Mater.*, no. 33, pp. 355–368, 1992.

[42] C. E. DUNN, "Participatory GIS a people's GIS?," *Prog. Hum. Geogr.*, vol. 31, no. 5, pp. 616–637, Oct. 2007.

[43] L. S. YAPA, "Is GIS appropriate technologyquest;," *Int. J. Geogr. Inf. Syst.*, vol. 5, no. 1, pp.

41–58, Jan. 1991.

[44] J. CENTELLES, “El buen gobierno de la ciudad: Estrategias urbanas y política relacional,” in *VIII Congreso Iberoamericano de Municipalistas*, 2006.

[45] M. F. GOODCHILD, “Citizens as sensors: the world of volunteered geography,” *GeoJournal*, vol. 69, no. 4, pp. 211–221, Nov. 2007.

[46] D. WOOD AND J. FELS, *The Power of Maps*. 1992, p. 248.

[47] I. WILLIAMSON, A. RAJABIFARD, J. WALLACE, AND R. BENNETT, “Spatially enabled society,” in *FIG Working Week 2011*, 2011, pp. 1–11.

[48] R. SIEBER, “Public Participation Geographic Information Systems: A Literature Review and Framework,” vol. 96, no. January, pp. 491–507, 2006.

[49] E. SHEPPARD, “GIS and Society: Towards a Research Agenda,” vol. 22, no. 1, pp. 5–16, Mar. 1995.

[50] B. J. HOWE, “The Rise of Crowdsourcing,” no. 14, pp. 1–5, 2012.

[51] Z. NEDOVIC-BUDIC, “Geographic Information Science Implications for Urban and Regional Planning,” *URISA*, vol. 12, no. 2, pp. 81–93, 2000.

[52] M. PAVLOVSKAYA, “Theorizing with GIS: a tool for critical geographies?,” *Environ. Plan. A*, vol. 38, no. 11, pp. 2003–2020, 2006.

[53] M. KAHILA AND M. KYTTÄ, “SoftGIS as a Bridge-Builder in Collaborative Urban Planning,” in *Planning Support Systems Best Practice an d New Methods*, 2009.

[54] H. RANTANEN AND M. KAHILA, “The SoftGIS approach to local knowledge.,” *J. Environ. Manage.*, vol. 90, no. 6, pp. 1981–90, May 2009.

[55] J. CORBURN, “Bringing Local Knowledge into Environmental Decision Making: Improving Urban Planning for Communities at Risk,” *J. Plan. Educ. Res.*, vol. 22, no. 4, pp. 420–433, Jun. 2003.

[56] J. FREIRE, “Monográfico ‘Cultura digital y prácticas creativas en educación,’” *UOC*, vol. 6, no. 1, Sep. 2009.

[57] D. DI SENA, “Hibridación físico-digital para la revitalización de los espacios públicos,” 2009.

[58] E. BONSÓN, L. TORRES, S. ROYO, AND F. FLORES, “Local e-government 2.0: Social media and corporate transparency in municipalities,” *Gov. Inf. Q.*, vol. 29, no. 2, pp. 123–132, Apr. 2012.

[59] A. CHADWICK, "Web 2.0: New Challenges for the Study of E-Democracy in an Era of Informational Exuberance," *A J. Law Policy Inf. Soc.*, vol. 5, 2008.

[60] SARTORI GIOVANNI, "Homo videns. La sociedad teledirigida." p. 159, 1998.

[61] B. W. DERESIEWICZ, "The End of Solitude." p. 10, 2009.

[62] D. SOROA, "'Utilizamos la tecnología como soporte de relación, el espacio público como lugar y la creatividad como forma,'" *Euskadi innova*, 12-Jul-2007. [Online]. Available: http://www.euskadinnova.net/es/innovacion-social/entrevistas/utilizamos-tecnologia-como-soporte-relacion-espacio-publico-como-lugar-creatividad-como-forma/302.aspx. [Accessed: 09-Jan-2015].

[63] M. DE LA P. ECHEVERRÍA, "Elementos para una caracterización actual del espacio público," *Trampas la Comun. y la Cult.*, vol. 71, pp. 1–14, 2012.

[64] P. FU AND J. SUN, *Web GIS: Principles and Applications*. Esri Press, 2010.

[65] S. S. KANHERE, "Participatory Sensing: Crowdsourcing Data from Mobile Smartphones in Urban Spaces," in *2011 IEEE 12th International Conference on Mobile Data Management*, 2011, vol. 2, pp. 3–6.

7. Appendix A: Database tables

User

User table has all the information related with users such as name, password… and also has geometry (point) in order to locate either the user's position, the answer's position or where was question created.

Preference

Preference table indicates all the areas on which the user is interested and the user's own areas. Preference is a geographic limit associated with one or more subjects. Preference table is related with Subject table through "many to many" relation.

Question

Question table storages all queries from users as well as the topics (maximum three) related to each question. In this table it is defined the nature of the question: kind of question, visibility, diffusion, etc. It is related with the Geographic_Limit table through "many to many" relation, adding a tag_question field to the relation table.

Answer

Answer table offers all the responses and states the time when it was answered.

Subject

Subject table defines the relation of subjects available for questions.

Geographic_Limit

Geographic_Limit table stipulates all the available boundaries to send the question. There are 54.665 zones accessible composed by autonomous communities, provinces, municipalities, districts and census sections of Spain.